Electronic Supplementary Material (ESI) for ChemComm.

Supporting Information

Catalyst-Controlled Site-Selective N-H and C3-Arylation of Carbazole *via* Carbene Transfer Reactions

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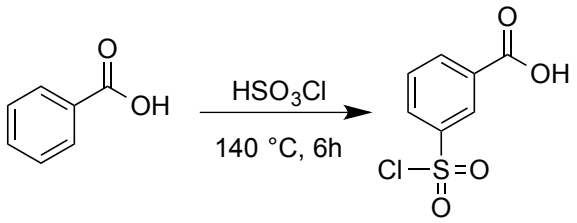
General Information

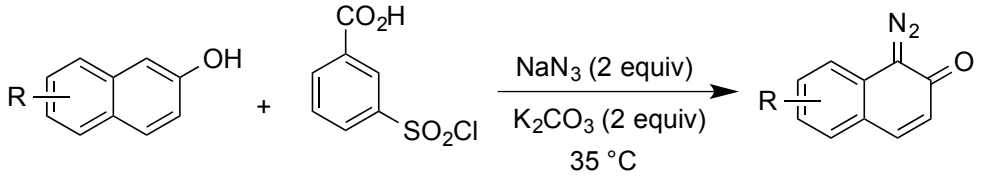
Unless otherwise noted, all commercially available compounds were used as provided without further purification. Chemicals used in this manuscript were purchased from Sigma Aldrich, Alfa Aesar, Fluorochem, Carl Roth and Evonik Industries (for Pd/C). Solvents used in reactions were p.A. grade. Solvents for chromatography were technical grade and distilled prior to use. Analytical thin-layer chromatography (TLC) was performed on Macherey-Nagel silica gel aluminium plates with F-254 indicator, visualised by irradiation with UV light. Column chromatography was performed using silica gel Merck 60 (particle size 0.063 - 0.2 mm). Solvent mixtures are understood as volume/volume. ^{1}H NMR, ^{19}F NMR and ^{13}CNMR were recorded on a Varian AV600/AV400 or an Agilent DD2 400 NMR spectrometer in $CDCl_3$. Data are reported in the following order: chemical shift (δ) in ppm; multiplicities are indicated br (broadened singlet), s (singlet), d (doublet), t (triplet), q (quartet), m (multiplet); coupling constants (*J*) are in Hertz (Hz). HRMS data were recorded on a ThermoFisher Scientific LTQ Orbitrap XL using ESI ionization or on a Finnigan MAT 95 using EI ionization at 70 eV. IR spectra were recorded on a Perkin Elmer-100 spectrometer and are reported in terms of frequency of absorption (cm^{-1}). LEDs used in this manuscript were purchased from Conrad Electronics: High Power LED-Module, 3 W, 30 lm, 470 nm, art.nr. 180745 – 62.

General procedures

General procedure for the preparation the 1-diazonaphthalen-2(1*H*)-one (GP-1)

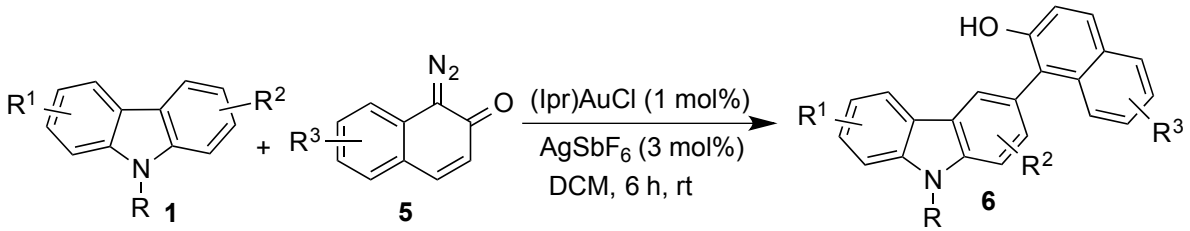


All diazoalkanes were synthesized according to the reported literature procedure.[1, 2] In a 250 mL oven-dried round-bottom flask, benzoic acid (6.1 g, 50 mmol) was added in one portion to chlorosulfonic acid (25.0 mL) under stirring at room temperature. The mixture was heated at 140 °C in an oil-bath for 6 hours. After completion of the reaction, the mixture was cooled down to room temperature. The resulting solution was slowly poured into finely crushed ice (100 g) maintaining temperature lower than 25 °C. A colorless precipitate was formed and filtered off by washing with cold water (2×25 mL). Then, the product was dried in vacuo (at 40 °C) for 1 hour to give 3-(chlorosulfonyl)benzoic acid as colorless powder (9.4 g, 85%) and the product was used for the next without further purification.



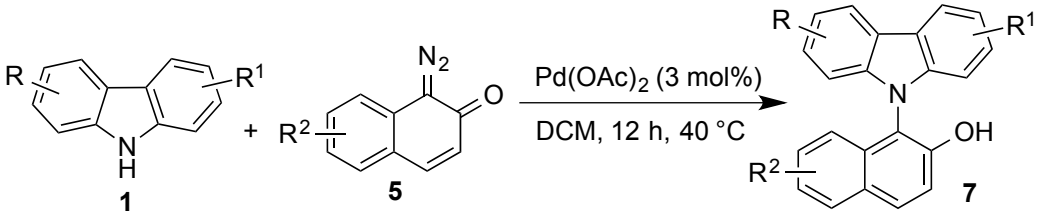
To a stirred solution of sodium azide (0.65 g, 10 mmol) in water (15 mL), potassium carbonate (1.38 g, 1 mmol) was added. After that, 3-(chlorosulfonyl)benzoic acid (2.2 g, 10 mmol) was added to the mixture and stirred for 10 min at room temperature. 2-Naphthol derivatives (5 mmol) were then slowly transferred to the reaction mixture and 2 mL of MeCN was added further. The reaction mixture was vigorously stirred for 10 hour at 35 °C. After completion of the reaction. the product was diluted and extracted with dichloromethane (3×50 mL), the organic layer was dried over magnesium sulphate and evaporated to dryness to afford diazo carbonyl compound. The crude product was purified by silica gel column chromatography using *n*-hexane/ ethyl acetate eluent to obtain the product as dark brown solid.

General procedure for the gold-catalyzed C3-arylation of carbazole (GP-2)



In a 10.0 mL oven-dried reaction tube, carbazole **1** (0.3 mmol, 1.5 equiv), [1,3-bis(2,6-diisopropylphenyl)imidazol-2-ylidene]AuCl (1 mol%, 1.2 mg) and $AgSbF_6$ (3 mol%, 2.1 mg) were taken and 1.0 mL of dry DCM was added. In another reaction tube, diazoalkane **5** (0.2 mmol, 1.0 equiv) was dissolved in 1 mL dry DCM and added to the reaction mixture over 1 hour *via* syringe pump. The reaction mixture was allowed to stir for 6 hours. After completion of the reaction, the crude product was purified by silica gel column chromatography using *n*-pentane/ diethyl ether as eluent.

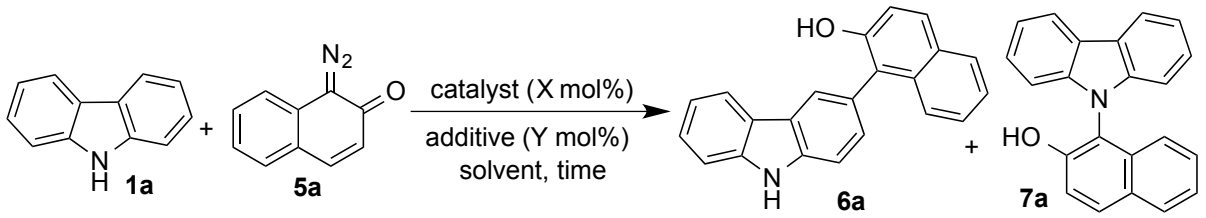
General procedure for the palladium-catalyzed N-H arylation of carbazole (GP-3)



In a 10.0 mL oven dried reaction tube, carbazole or heterocycle **1** (0.2 mmol, 1.0 equiv), diazoalkane **5** (0.3 mmol, 1.5 equiv), $Pd(OAc)_2$ (3 mol%, 1.4 mg) were taken and 2.0 mL of dry DCM was added. The reaction mixture was allowed to stir at 40 °C for 12 hours. After completion of the reaction, the crude product was purified by silica gel column chromatography using *n*-pentane/ diethyl ether as eluent.

Reaction Optimization

Table S1. Optimization table for C3-arylation of carbazole



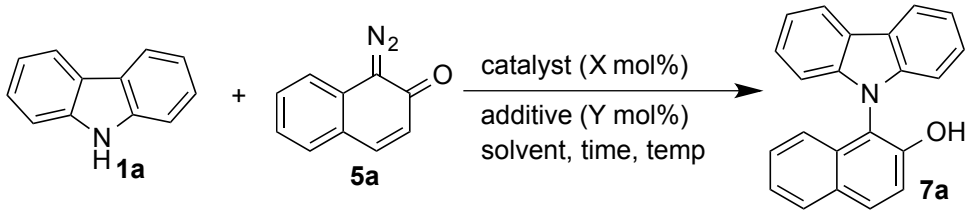
Entry [a]	1a/5a (equiv)	Catalyst (X mol%)	Additive (Y mol%)	Solvent	Reaction time (h)[b]	Yield (%) 6a/7a[c]
1	1: 1	(^{t}Bu$_3$P)AuCl (5)	$AgSbF_6$ (10)	DCM	12 (3)	22/-
2	1: 1	(L^1)AuCl (5)	$AgSbF_6$ (10)	DCM	12 (3)	-/-
3	1: 1	(Ipr)AuCl (5)	$AgSbF_6$ (10)	DCM	12 (3)	52(12)[d] /3
4	1.5:1	(Ipr)AuCl (3)	$AgSbF_6$ (6)	DCM	3.5 (3)	68/5
5	1:1	(Ipr)AuCl (3)	$AgSbF_6$ (6)	DCM	3.5 (3)	63/4
6	1:1.5	(Ipr)AuCl (3)	$AgSbF_6$ (6)	DCM	3.5 (3)	60(14)[d]/-
7	1:2	(Ipr)AuCl (3)	$AgSbF_6$ (6)	DCM	3.5 (3)	54(18)[d]/-
8	1.5:1	(Ipr)AuCl (3)	$AgSbF_6$ (6)	THF	3.5 (3)	-/-
9	1.5:1	(Ipr)AuCl (3)	$AgSbF_6$ (6)	1,4-dioxane	3.5 (3)	5/-
10	1.5:1	(Ipr)AuCl (3)	$AgSbF_6$ (6)	1,2-DCE	3.5 (3)	59/4
11	1.5:1	(Ipr)AuCl (3)	$AgSbF_6$ (6)	$CHCl_3$	3.5 (3)	56/5
12	1.5:1	(Ipr)AuCl (3)	$AgSbF_6$ (6)	MeCN	3.5 (3)	5/-
13	1.5:1	(Ipr)AuCl (3)	$AgSbF_6$ (6)	DCM	2.5 (2)	70/5
14	1.5:1	(Ipr)AuCl (3)	$AgSbF_6$ (6)	DCM	1.5 (1)	72/6
15	1.5:1	(Ipr)AuCl (3)	$AgSbF_6$(6)	DCM	1.0 (0.5)	68/5
16	1.5:1	(Ipr)AuCl (3)	$AgSbF_6$ (6)	DCM	0.5 (0.25)	67/5
17	1.5: 1	(^{t}Bu$_3$P)AuCl (3)	$AgSbF_6$ (6)	DCM	1.5 (1)	20/-
18	1.5:1	^{t}BuXPhos AuCl (3)	$AgSbF_6$ (6)	DCM	1.5 (1)	14/-

19	1.5:1	dppf$(AuCl)_2$ (3)	$AgSbF_6$ (6)	DCM	1.5 (1)	-/-
20	1.5:1	$(L^2)AuN(SO_2CF_3)_2$ (3)	$AgSbF_6$ (6)	DCM	1.5 (1)	8/-
21	1.5:1	JohnPhosAuCl (3)	$AgSbF_6$ (6)	DCM	1.5 (1)	35/-
22	1.5:1	(IMes)AuCl (3)	$AgSbF_6$ (6)	DCM	1.5 (1)	36/-
23	1.5:1	(Ipr)AuCl (2)	$AgSbF_6$ (4)	DCM	1.5 (1)	73/3
24	1.5:1	(Ipr)AuCl (1)	$AgSbF_6$ (3)	DCM	1.5 (1)	57/-
25	1.5:1	(Ipr)AuCl (0.5)	$AgSbF_6$ (2)	DCM	1.5 (1)	48/-
26	1.5:1	(Ipr)AuCl (1)	$AgSbF_6$ (3)	DCM	6 (1)	76/3
27	1.5:1	(Ipr)AuCl (1)	$AgPF_6$ (3)	DCM	6 (1)	66/-
28	1.5:1	(Ipr)AuCl (1)	$AgNTf_2$ (3)	DCM	6 (1)	51/-
29	1.5:1	(Ipr)AuCl (1)	$AgBF_4$ (3)	DCM	6 (1)	53/-
30	1.5:1	-	$AgSbF_6$ (3)	DCM	6 (1)	-/-
31	1.5:1	(Ipr)AuCl (1)	-	DCM	6 (1)	-/-
32	1.5:1	(Ipr)AuCl (1)	(Trop)BF_4 (5)	DCM	6 (1)	-/-
33	1.5:1	-	(Trop)BF_4 (10)	DCM	6 (1)	-/-
34	1.5:1	(Ipr)AuCl (1)	$(Ph_3C)BF_4$ (5)	DCM	6 (1)	-/-
35	1.5:1	-	$(Ph_3C)BF_4$ (5)	DCM	6 (1)	-/-
36	1.5:1	(Ipr)AuCl (1)	HBF_4 (5)	DCM	6 (1)	-/-
37	1.5:1	-	HBF_4 (10)	DCM	6 (1)	-/-
38	1.5:1	(Ipr)AuCl (1)	$AgSbF_6$ (3) + HBF_4 (5)	DCM	6 (1)	61/-
39	1:1	Blue light (470 nm)	-	DCM	6	-/-

[a]*Reaction conditions*: Limiting substrate was taken in 0.2 mmol scale and dissolved in 2.0 mL of solvent. [b]time of slow addition was reported in bracket, [c]Isolated yield. [d]In the parenthesis diproduct 1,1'-(9*H*-carbazole-3,6-diyl)bis(naphthalen-2-ol), **9** is reported. L^1 = Tris(2,4-di-tert-butylphenyl)phosphite, *t*BuXPhosAuCl = 2-Di-tert-butylphosphin-2′,4′,6′-triisopropylbiphenyl, dppf = 1,1′-bis-(diphenylphoshino)ferrocene, L^2 = Tri-tert-butylphosphine, JohnPhos = (2-Biphenylyl)-di-tert.-butylphosphine, Ipr = 1,3-bis(2,6-diisopropyl phenyl)imidazol-2-ylidene, IMes = 1,3-dimesitylimidazol-2-ylidene, Trop = Tropylium. In case of no product formation, diazoalkane **5a** stayed untouched in the reaction mixture.

Reaction Optimization

Table S2. Optimization table for N-H arylation of carbazole



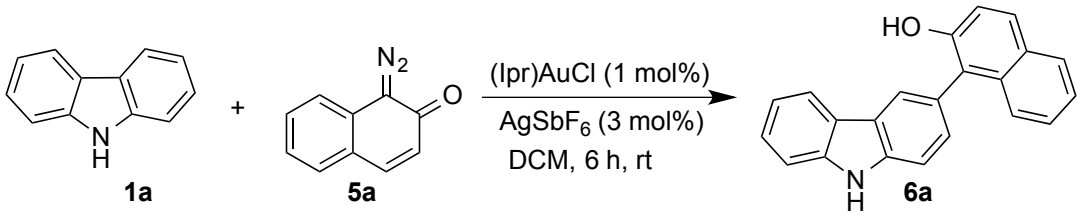
Entry[a]	Catalyst (X mol%)	Additive (Y mol%)	Solvent	Temp (°C)	Time (h)	Yield (7a) (%)[b]
1	$Pd(OAc)_2$ (5)	-	DCM	25	24	45
2	$Pd(OAc)_2$ (5)	-	DCM	32	24	74
3	$Pd(OAc)_2$ (5)	-	DCM	40	24	81
4	$Pd(OAc)_2$ (5)	PPh_3 (10)	DCM	40	24	-
5	$Pd(OAc)_2$ (5)	2,2′-Bipyridine	DCM	40	24	-
6	$Pd(OAc)_2$ (5)	Xantphos (10)	DCM	40	24	-
7	$Pd(OAc)_2$ (5)	SPhos (10)	DCM	40	24	6
8	$Pd(OAc)_2$ (5)	XPhos (10)	DCM	40	24	15
9	$Rh(OAc)_2$ (5)	-	DCM	40	24	84
10	$Cu(OAc)_2$ (5)	-	DCM	40	24	-
11	$[Cu(OTf)]_2.C_6H_6$	-	DCM	40	24	-
12	$[Cu(MeCN)_4]BF_4$	-	DCM	40	24	-
13	$Co(OAc)_2$ (5)	-	DCM	40	24	-
14	$Mn(OAc)_2$ (5)	-	DCM	40	24	-
15	$Pd(OAc)_2$ (5)	-	DCM	40	18	85
16	$Pd(OAc)_2$ (5)	-	DCM	40	12	90
17	$Pd(OAc)_2$ (5)	-	DCM	40	6	82
18	$Pd(OAc)_2$ (4)	-	DCM	40	12	88

19	$Pd(OAc)_2$ (3)	-	DCM	40	12	91
20	$Pd(OAc)_2$ (2)	-	DCM	40	12	81
21	$Rh_2(OAc)_4$ (4)	-	DCM	40	12	87
22	$Rh_2(OAc)_4$ (4)	-	DCM	40	12	76
23	$Pd(OAc)_2$ (3)	-	THF	40	12	85
24	$Pd(OAc)_2$ (3)	-	1,2-DCE	40	12	89
25	$Pd(OAc)_2$ (3)	-	1,4-dioxane	40	12	69
26	$Pd(OAc)_2$ (3)	-	Tolune	40	12	76
27	$Pd(OAc)_2$ (3)	-	EtOAc	40	12	58
28	$Pd(CF_3CO_2)_2$ (3)	-	DCM	40	12	86
29	$Pd(PPh_3)_2Cl_2$ (3)	-	DCM	40	12	-
30	$Pd(PPh_3)_4$ (3)	-	DCM	40	12	-
31	$Pd(dba)_2$ (3)	-	DCM	40	12	83
32	$PdCl_2$ (3)	-	DCM	40	12	89
33	Pd/C (5 wt%) (3)	-	DCM	40	12	-
34	$Pd(OAc)_2$ (3)	H_2O (50)	DCM	40	12	91
35	$Pd(OAc)_2$ (3)	H_2O (100)	DCM	40	12	88
36	$Pd(OAc)_2$ (3)	AcOH (50)	DCM	40	12	88
37	$Pd(OAc)_2$ (3)	AcOH (100)	DCM	40	12	86
38[c]	$Pd(OAc)_2$ (3)	-	DCM	40	12	90
39[d]	$Pd(OAc)_2$ (3)	-	DCM	40	12	82

[a]*Reaction conditions*: 0.2 mmol **1a** (1.0 equiv), 0.3 mmol **5a** (1.5 equiv), were dissolved in 2.0 mL of solvent, [b]Isolated yield, [c]2 equiv diazoalkane was taken, [d]1.2 equiv diazoalkane **5a** was taken. dba = bis(dibenzylideneacetone). In case of no product formation, diazoalkane **5a** stayed untouched in the reaction mixture.

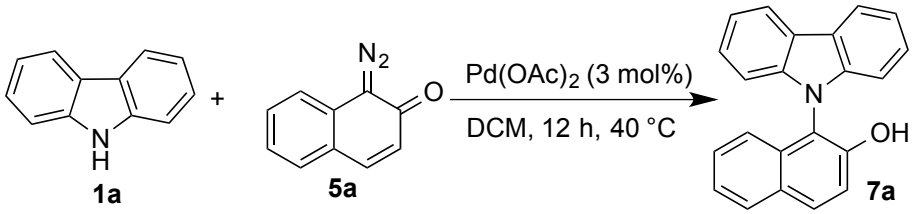
Scale-up Experiment

Procedure for the scale-up experiment of the C3-arylation product (6a)



In a 30.0 mL oven dried reaction tube, carbazole **1** (4.5 mmol, 1.5 equiv), [1,3-bis(2,6-diisopropylphenyl)imidazol-2-ylidene]AuCl (1 mol%, 18.6 mg) and $AgSbF_6$ (3 mol%, 30.9 mg) were taken and 10.0 mL of dry DCM was added. In another reaction tube, diazoalkane **5a** (3 mmol, 1.0 equiv) was dissolved in 5 mL dry DCM and added to the reaction mixture over 1 hour *via* syringe pump. The reaction mixture was allowed to stir for 6 hours. After completion of the reaction, the crude product was directly purified by silica gel column chromatography (*n*-pentane : diethyl ether – 20:1 → 2:1) and obtained product **6a** as a colorless solid (0.41 g, 44%).

Procedure for the scale-up experiment of the N-H arylation product (7a)

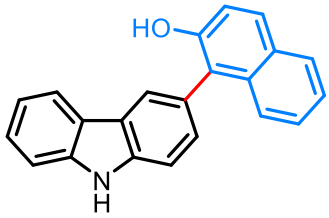


In a 30.0 mL oven dried reaction tube, carbazole **1a** (3.0 mmol, 0.5 g), diazoalkane **5a** (4.5 mmol, 0.77 g), $Pd(OAc)_2$ (0.09 mmol, 3 mol%, 20.2 mg) were taken and 10.0 mL of dry DCM was added it. The resultant reaction mixture was allowed to stir at 40 °C for 12 hours. After completion of the reaction, the crude product was directly purified by silica gel column chromatography (*n*-pentane : diethyl ether – 20:1 → 4:1) and obtained product **7a** as a colorless solid (0.76 g, 82%).

* Use of 2 mol% $Pd(OAc)_2$ offered the product **7a** in 78% (0.72g) yield and 1 mol% $Pd(OAc)_2$ provided the product **7a** in 62% (0.57g) yield.

Characterization of products

1-(9*H*-Carbazol-3-yl)naphthalen-2-ol (6a)



The title compound **6a** was synthesized according to the **GP-2** and isolated after silica gel column chromatography (*n*-pentane : diethyl ether – 20:1 → 2:1) as a colorless solid (76%, 46.9 mg).

m.p.: 186 – 188 °C.

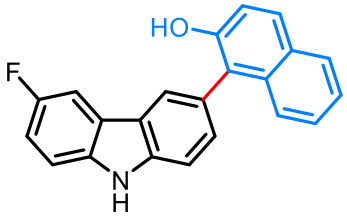
^{1}H NMR (600 MHz, $CDCl_3$): δ = 8.16 (br, 1H), 8.15 (s, 1H), 8.06 (d, *J* = 7.8 Hz, 1H), 7.87 (d, *J* = 8.9 Hz, 2H), 7.60 (d, *J* = 8.2 Hz, 1H), 7.50 – 7.47 (m , 3H), 7.45 (dd, *J* = 8.2, 1.1 Hz, 1H), 7.37 – 7.33 (m, 3H), 7.30 – 7.27 (m, 1H), 5.37 (s, 1H) ppm

^{13}C NMR (151 MHz, $CDCl_3$): δ = 150.8, 140.0, 139.5, 134.1, 129.4, 129.1, 128.8, 128.2, 126.6, 126.5, 125.1, 124.6, 124.5, 123.4, 123.2, 123.1, 121.8, 120.7, 120.1, 117.4, 111.9, 111.0 ppm.

HRMS (APCI) *m/z*: $[M]^+$ Calcd. for $C_{22}H_{15}NO^+$ 309.1142; Found 309.1149.

IR (KBr): 3853, 3510, 3412, 3056, 2926, 2669, 2483, 2250, 2109, 1897, 1771, 1598, 1489, 1461, 1387, 1334, 1268, 1237, 1201, 1169, 1143, 1021, 984, 948, 904, 814, 727 cm^{-1}.

1-(6-Fluoro-9*H*-carbazol-3-yl)naphthalen-2-ol (6b)



The title compound **6b** was synthesized according to the **GP-2** and isolated after silica gel column chromatography (*n*-pentane : diethyl ether – 20:1 → 2:1) as a colorless solid (65%, 42.7 mg).

m.p.: 152 – 156 °C.

^{1}H NMR (600 MHz, $CDCl_3$): δ = 8.09 (br, 1H), 7.96 (s, 1H), 7.75 – 7.74 (m, 2H), 7.57 (d, *J* = 8.7 Hz, 1H), 7.47 (d, *J* = 8.2 Hz, 1H), 7.35 – 7.32 (m, 2H), 7.28 – 7.22 (m, 4H), 7.09 (td, *J* = 8.9, 2.1 Hz, 1H), 5.22 (s, 1H) ppm.

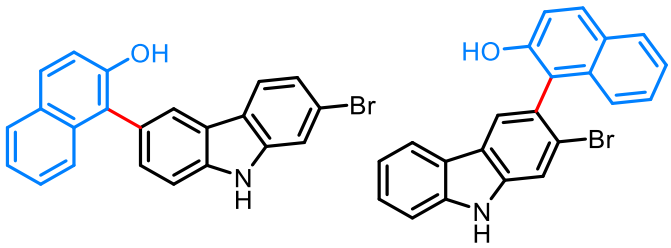
^{13}C NMR (151 MHz, $CDCl_3$): δ = 157.8 (d, *J* = 236.4 Hz), 150.8, 140.5, 136.3, 134.1, 129.5 (d, *J* = 10.2 Hz), 129.1, 128.2, 126.6, 125.0, 124.8, 124.3 (d, *J* = 3.8 Hz), 123.4, 123.7, 123.6, 123.4, 121.6, 117.4, 114.5 (d, *J* = 25.5 Hz), 112.2, 111.6 (d, *J* = 9.3 Hz), 106.3 (d, *J* = 23.7 Hz) ppm.

^{19}F NMR (565 MHz, Chloroform-*d*): δ = -123.49 – -123.53 (m) ppm.

HRMS (APCI) *m/z*: $[M + H]^+$ Calcd. for $C_{22}H_{15}NOF^+$ 328.1132; Found 328.1132.

IR (KBr): 3864, 3512, 3415, 3058, 2923, 2855, 2657, 2323, 2202, 2074, 1990, 1937, 1898, 1713, 1618, 1592, 1491, 1462, 1386, 1343, 1281, 1202, 1143, 1047, 953, 920, 859, 807, 741 cm^{-1}.

1-(7-Bromo-9*H*-carbazol-3-yl)naphthalen-2-ol (6c) and 1-(2-Bromo-9*H*-carbazol-3-yl)naphthalen-2-ol (6c')



The title compound **6c** was synthesized according to the **GP-2** and isolated after silica gel column chromatography (*n*-pentane : diethyl ether – 20:1 → 2:1) as a colorless solid (68%, 52.8 mg).

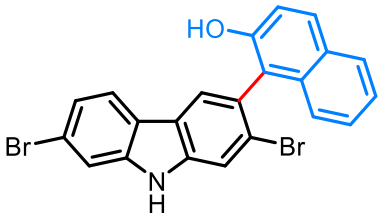
^{1}H NMR (600 MHz, $CDCl_3$): δ = 8.22 (br, 1H), 8.10 (s, 0.72H), 8.08 (s, 0.28H), 7.99 (d, *J* = 7.7 Hz, 0.28H), 7.91 – 7.84 (m, 3H), 7.64 – 7.62 (m, 1.6H), 7.50 – 7.44 (m, 2H), 7.38 – 7.31 (m, 4H), 7.23 (d, *J* = 9.3 Hz, 0.28H), 5.27 (s, 0.73H), 5.01 (s, 0.26H) ppm.

^{13}C NMR (151 MHz, $CDCl_3$): δ = 150.9, 150.8, 140.8, 140.5, 140.1, 139.5, 134.0, 133.8, 130.1, 129.6, 129.4, 129.1, 129.0, 128.23, 128.19, 127.1, 126.8, 126.6, 125.4, 125.21, 125.20, 125.0, 124.7, 124.6, 124.1, 123.5, 123.40, 123.39, 123.2, 122.8, 122.6, 122.1, 121.9, 121.5, 121.2, 120.7, 120.6, 120.1, 117.5, 117.4, 115.6, 114.1, 112.2, 111.1 ppm.

HRMS (ESI) *m/z*: $[M + H]^+$ Calcd. for $C_{22}H_{15}NOBr^+$ 388.0332; Found 388.0332.

IR (KBr): 3848, 3509, 3408, 3053, 2926, 2660, 2325, 2250, 2111, 1991, 1895, 1709, 1619, 1590, 1514, 1462, 1385, 1348, 1273, 1189, 1143, 1041, 946, 904, 860, 808, 735, 694 cm^{-1}.

1-(2,7-Dibromo-9*H*-carbazol-3-yl)naphthalen-2-ol (6d)



The title compound **6d** was synthesized according to the **GP-2** and isolated after silica gel column chromatography (*n*-pentane : diethyl ether – 20:1 → 2:1) as a colorless solid (66%, 61.4 mg).

m.p.: 242 – 248 °C.

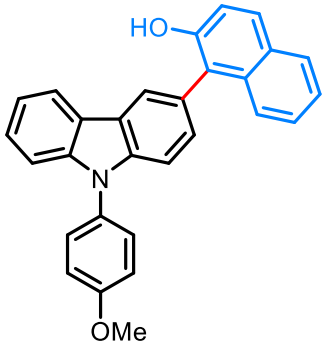
^{1}H NMR (600 MHz, $CDCl_3$): δ = 8.24 (br, 1H), 8.04 (s, 1H), 7.91 (s, 1H), 7.89 (d, *J* = 8.9 Hz, 1H), 7.87 – 7.85 (m, 1H), 7.82 (d, *J* = 8.3 Hz, 1H), 7.64 (d, *J* = 0.7 Hz, 1H), 7.37 (dd, *J* = 8.4, 1.2 Hz, 1H), 7.35 – 7.33 (m, 2H), 7.32 (d, *J* = 8.9 Hz, 1H), 7.21 – 7.20 (m, 1H), 4.96 (s, 1H) ppm.

^{13}C NMR (151 MHz, $CDCl_3$): δ (ppm) 150.9, 140.8, 140.5, 133.8, 130.2, 129.0, 128.3, 126.8, 126.0, 124.64, 124.61, 123.9, 123.6, 123.5, 123.3, 121.9, 121.6, 121.0, 120.6, 117.5, 115.8, 114.2.

HRMS (APCI) *m/z*: $[M +H]^+$ Calcd. for $C_{22}H_{14}NO^{79}Br_2^+$ 465.9437; Found 465.9437.

IR (KBr): 3820, 3472, 3361, 3053, 2925, 2659, 2325, 2166, 2070, 1994, 1914, 1854, 1760, 1674, 1599, 1508, 1457, 1419, 1394, 1334, 1267, 1236, 1113, 1033, 985, 948, 888, 836, 796, 755, 723, 674 cm^{-1}.

1-(9-(4-Methoxyphenyl)-9*H*-carbazol-3-yl)naphthalen-2-ol (6e)



The title compound **6e** was synthesized according to the **GP-2** and isolated after silica gel column chromatography (*n*-pentane : diethyl ether – 20:1 → 2:1) as a colorless solid (76%, 63.0 mg).

m.p.: 177 – 180 °C.

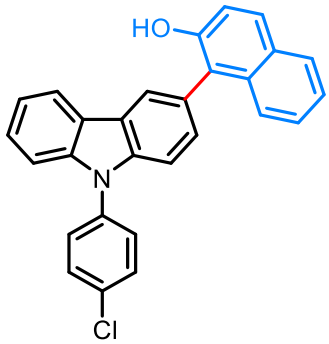
^{1}H NMR (400 MHz, $CDCl_3$): δ = 8.16 (s, 1H), 8.07 (d, *J* = 7.7 Hz, 1H), 7.80 (d, *J* = 8.4 Hz, 2H), 7.50 – 7.46 (m, 4H), 7.44 – 7.35 (m, 3H), 7.32 – 7.24 (m, 4H), 7.11 (d, *J* = 8.8 Hz, 2H), 5.34 (s, 1H), 3.89 (s, 3H) ppm.

^{13}C NMR (101 MHz, $CDCl_3$): δ = 159.2, 150.7, 141.9, 141.3, 134.0, 130.1, 129.3, 129.0, 128.8, 128.6, 128.1, 126.5, 126.4, 125.0, 124.8, 124.2, 123.2, 123.0, 122.8, 121.7, 120.5, 120.2, 117.3, 115.3, 111.0, 110.1, 55.67 ppm.

HRMS (ESI) *m/z*: $[M + Na]^+$ Calcd. for $C_{29}H_{21}NO_2Na^+$ 438.1465; Found 438.1473.

IR (KBr): 3521, 3054, 2958, 2837, 2250, 2052, 1895, 1730, 1619, 1596, 1511, 1459, 1386, 1326, 1291, 1240, 1178, 1144, 1030, 944, 906, 816, 729, 679 cm^{-1}.

1-(9-(4-Chlorophenyl)-9*H*-carbazol-3-yl)naphthalen-2-ol (6f)



The title compound **6f** was synthesized according to the **GP-2** and isolated after silica gel column chromatography (*n*-pentane : diethyl ether – 20:1 → 2:1) as a colorless solid (64%, 54.0 mg).

m.p.: 165 – 169 °C.

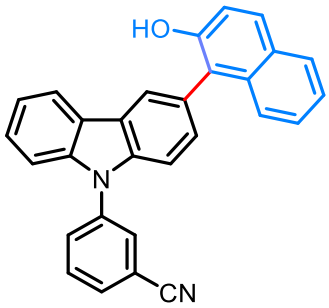
^{1}H NMR (600 MHz, $CDCl_3$): δ = 8.22 (s, 1H), 8.13 (d, *J* = 7.7 Hz, 1H), 7.86 (d, *J* = 8.7 Hz, 2H), 7.64 (d, *J* = 8.5 Hz, 2H), 7.60 – 7.58 (m, 3H), 7.51 – 7.44 (m, 4H), 7.36 – 7.34 (m, 4H), 5.35 (s, 1H) ppm.

^{13}C NMR (151 MHz, $CDCl_3$): δ = 150.8, 141.3, 140.8, 136.2, 134.1, 133.6, 130.4, 129.5, 129.14, 129.11, 128.6, 128.2, 126.9, 126.6, 125.6, 125.0, 124.7, 123.4, 123.24, 123.22, 121.6, 120.8, 120.7, 117.4, 111.0, 110.0 ppm.

HRMS (APCI) *m/z*: $[M + H]^+$ Calcd. for $C_{28}H_{19}NOCl^+$ 420.1150; Found 420.1149.

IR (KBr): 3523, 3057, 2925, 2663, 2251, 2178, 2078, 1901, 1729, 1619, 1595, 1493, 1457, 1386, 1324, 1268, 1229, 1172, 1143, 1091, 1015, 941, 905, 815, 729 cm^{-1}.

3-(3-(2-Hydroxynaphthalen-1-yl)-9*H*-carbazol-9-yl)benzonitrile (6g)



The title compound **6g** was synthesized according to the **GP-2** and isolated after silica gel column chromatography (*n*-pentane : diethyl ether – 20:1 → 2:1) as a colorless solid (62%, 50.8 mg).

m.p.: 212 – 219 °C.

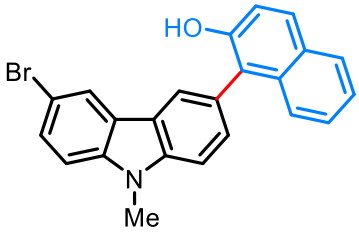
^{1}H NMR (600 MHz, $CDCl_3$): δ = 8.22 (s, 1H), 8.13 (d, *J* = 7.9 Hz, 1H), 7.97 (s, 1H), 7.93 (d, *J* = 7.2 Hz, 1H), 7.86 (d, *J* = 8.9 Hz, 2H), 7.81 – 7.77 (m, 2H), 7.59 (d, *J* = 8.3 Hz, 1H), 7.51 – 7.47 (m, 3H), 7.44 (d, *J* = 8.3 Hz, 1H), 7.38 – 7.33 (m, 4H), 5.31 (s, 1H) ppm.

^{13}C NMR (151 MHz, $CDCl_3$): δ (ppm) 150.8, 140.9, 140.3, 138.8, 134.0, 131.7, 131.3, 131.2, 130.5, 129.6, 129.4, 129.1, 128.2, 127.1, 126.6, 126.3, 125.0, 124.9, 123.5, 123.4, 121.4, 121.0, 117.5, 114.6, 110.7, 109.7.

HRMS (APCI) *m/z*: $[M+H]^+$ Calcd. for $C_{29}H_{19}NO^+$ 411.1492; Found 411.1483.

IR (KBr): 3521, 3382, 3055, 2925, 2681, 2323, 2242, 2166, 2107, 1990, 1897, 1767, 1595, 1486, 1456, 1386, 1323, 1268, 1223, 1168, 1144, 1026, 983, 950, 916, 889, 856, 813, 741, 692 cm^{-1}.

1-(6-Bromo-9-methyl-9*H*-carbazol-3-yl)naphthalen-2-ol (6h)



The title compound **6h** was synthesized according to the **GP-2** and isolated after silica gel column chromatography (*n*-pentane : diethyl ether – 20:1 → 2:1) as a colorless solid (73%, 59.0 mg).

m.p.: 189 – 191 °C.

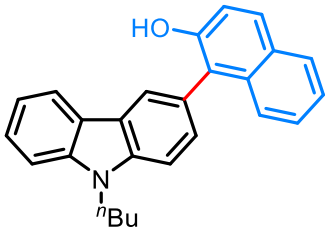
^{1}H NMR (600 MHz, $CDCl_3$): δ = 8.18 (d, *J* = 1.5 Hz, 1H), 8.11 (s, 1H), 7.85 (d, *J* = 8.4 Hz, 2H), 7.62 – 7.60 (m, 2H), 7.53 (d, *J* = 8.3 Hz, 1H), 7.43 (d, *J* = 8.9 Hz, 1H), 7.35 – 7.31 (m, 4H), 5.27 (s, 1H), 3.93 (s, 3H) ppm.

^{13}C NMR (151 MHz, $CDCl_3$): δ = 150.7, 141.2, 140.1, 133.9, 129.4, 129.3, 129.0, 128.1, 126.5, 124.8, 124.5, 124.1, 123.32, 123.25, 123.23, 122.8, 121.4, 117.3, 112.2, 110.2, 110.0, 29.4 ppm.

HRMS (ESI) *m/z*: $[M+Na]^+$ Calcd. for $C_{23}H_{16}NOBrNa^+$ 424.0308; Found 424.0319.

IR (KBr): 3626, 3515, 3055, 2930, 2826, 2325, 2078, 1884, 1727, 1618, 1594, 1509, 1483, 1384, 1350, 1282, 1243, 1205, 1168, 1142, 1049, 1021, 987, 949, 903, 863, 807, 730, 671 cm^{-1}.

1-(9-Butyl-9*H*-carbazol-3-yl)naphthalen-2-ol (6i)



The title compound **6i** was synthesized according to the **GP-2** and isolated after silica gel column chromatography (*n*-pentane : diethyl ether – 20:1 → 2:1) as a colorless solid (80%, 58.6 mg).

m.p.: 155 – 158 °C.

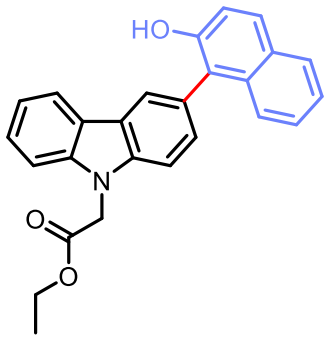
^{1}H NMR (600 MHz, $CDCl_3$): δ = 8.15 (s, 1H), 8.06 (d, *J* = 7.7 Hz, 1H), 7.83 (d, *J* = 8.7 Hz, 2H), 7.60 (d, *J* = 8.3 Hz, 1H), 7.52 – 7.47 (m, 4H), 7.34 – 7.30 (m, 3H), 7.24 (d, *J* = 8.0 Hz, 1H), 5.35 (s, 1H), 4.38 (t, *J* = 7.2 Hz, 2H), 1.96 – 1.91 (m, 2H), 1.51 – 1.45 (m, 2H), 1.01 (t, *J* = 7.4 Hz, 3H) ppm.

^{13}C NMR (151 MHz, $CDCl_3$): δ = 150.7, 140.9, 140.4, 134.1, 129.2, 129.0, 128.5, 128.0, 126.4, 126.3, 125.0, 123.9, 123.7, 123.2, 123.1, 122.5, 121.8, 120.6, 119.3, 117.3, 109.9, 109.0, 43.1, 31.3, 20.7, 14.0 ppm.

HRMS (ESI) *m/z*: $[M + H]^+$ Calcd. for $C_{26}H_{24}NO^+$ 366.1852; Found 366.1856.

IR (KBr): 3869, 3517, 3053, 2956, 2930, 2869, 2323, 2067, 1994, 1890, 1767, 1618, 1596, 1464, 1385, 1340, 1268, 1244, 1207, 1168, 1143, 1068, 1023, 985, 949, 892, 813, 777, 745, 666 cm^{-1}.

Ethyl 2-(3-(2-hydroxynaphthalen-1-yl)-9*H*-carbazol-9-yl)acetate (6j)



The title compound **6j** was synthesized according to the **GP-2** and isolated after silica gel column chromatography (*n*-pentane : diethyl ether – 20:1 → 2:1) as a colorless solid (70%, 55.1 mg).

m.p.: 142 – 147 °C.

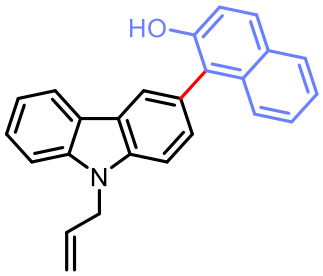
^{1}H NMR (600 MHz, $CDCl_3$): δ = 8.18 (s, 1H), 8.09 (d, *J* = 7.7 Hz, 1H), 7.86 (d, *J* = 8.4 Hz, 2H), 7.55 (t, *J* = 8.1 Hz, 2H), 7.52 – 7.48 (m, 2H), 7.42 (d, *J* = 8.2 Hz, 1H), 7.35 – 7.34 (m, 3H), 7.31 (t, *J* = 7.5 Hz, 1H), 5.38 (s, 1H), 5.09 (s, 2H), 4.29 (q, *J* = 7.1 Hz, 2H), 1.32 (t, *J* = 7.1 Hz, 3H) ppm.

^{13}C NMR (151 MHz, $CDCl_3$): δ = 168.5, 150.9, 141.1, 140.6, 134.1, 129.4, 129.1, 129.0, 128.1, 126.7, 126.5, 125.1, 124.9, 124.5, 123.3, 123.0, 121.7, 120.9, 120.3, 117.4, 109.8, 108.8, 62.0, 45.0, 14.3 ppm.

HRMS (ESI) *m/z*: $[M + Na]^+$ Calcd. for $C_{26}H_{21}NO_3Na^+$ 418.1414; Found 418.1414.

IR (KBr): 3518, 3054, 2982, 2932, 2251, 2035, 1894, 1736, 1597, 1465, 1429, 1383, 1344, 1268, 1197, 1072, 1023, 948, 907, 814, 730, 670 cm^{-1}.

1-(9-Allyl-9*H*-carbazol-3-yl)naphthalen-2-ol (6k)



The title compound **6k** was synthesized according to the **GP-2** and isolated after silica gel column chromatography (*n*-pentane : diethyl ether – 20:1 → 4:1) as a colorless solid (69%, 48 mg).

m.p.: 136 – 138 °C.

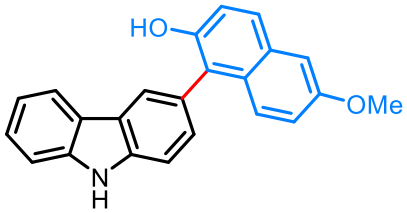
^{1}H NMR (600 MHz, $CDCl_3$): δ = 8.20 (s, 1H), 8.10 (d, *J* = 7.7 Hz, 1H), 7.87 (d, *J* = 8.6 Hz, 2H), 7.60 (d, *J* = 8.2 Hz, 1H), 7.55 – 7.50 (m, 3H), 7.48 (d, *J* = 8.2 Hz, 1H), 7.37 – 7.35 (m, 3H), 7.30 (t, *J* = 7.4 Hz, 1H), 6.12 – 6.06 (m, 1H), 5.39 (s, 1H), 5.28 (d, *J* = 10.3 Hz, 1H), 5.19 (d, *J* = 17.1 Hz, 1H), 5.01 (d, *J* = 4.3 Hz, 2H) ppm.

^{13}C NMR (151 MHz, $CDCl_3$): δ = 150.9, 141.0, 140.4, 134.2, 132.3, 129.4, 129.1, 128.7, 128.1, 126.5, 125.1, 124.2, 124.1, 123.3, 123.2, 122.7, 121.8, 120.7, 119.7, 117.4, 117.3, 110.1, 109.2, 45.6 ppm.

HRMS (ESI) *m/z*: $[M + Na]^+$ Calcd. for $C_{25}H_{19}NONa^+$ 372.1359; Found 372.1370.

IR (KBr): 3518, 3055, 2921, 2859, 2326, 2076, 1892, 1728, 1618, 1596, 1464, 1385, 1330, 1269, 1209, 1168, 1143, 1028, 986, 907, 812, 731 cm^{-1}.

1-(9*H*-Carbazol-3-yl)-6-methoxynaphthalen-2-ol (6l)



The title compound **6l** was synthesized according to the **GP-2** and isolated after silica gel column chromatography (*n*-pentane : diethyl ether – 20:1 → 2:1) as a colorless solid (74%, 50.2 mg).

m.p.: 172 – 178 °C.

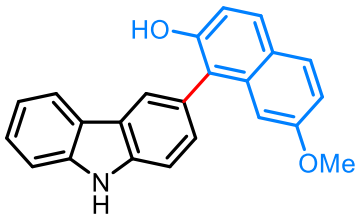
^{1}H NMR (600 MHz, $CDCl_3$): δ = 8.23 (br, 1H), 8.13 (s, 1H), 8.05 (d, *J* = 7.8 Hz, 1H), 7.73 (d, *J* = 8.9 Hz, 1H), 7.62 (d, *J* = 8.2 Hz, 1H), 7.51 – 7.46 (d, J = 27.8 Hz, 2H), 7.43 (d, *J* = 8.2 Hz, 1H), 7.38 (d, *J* = 9.2 Hz, 1H), 7.30 (d, *J* = 8.9 Hz, 1H), 7.28 – 7.26 (m, 1H), 7.18 (d, *J* = 2.5 Hz, 1H), 7.01 (dd, *J* = 9.2, 2.5 Hz, 1H), 5.18 (s, 1H), 3.92 (s, 3H) ppm.

^{13}C NMR (151 MHz, $CDCl_3$): δ (ppm) 156.0, 149.2, 140.0, 139.5, 130.0, 129.4, 128.8, 128.0, 126.7, 126.6, 124.8, 124.6, 123.1, 122.1, 120.7, 120.1, 119.0, 117.8, 111.9, 111.0, 106.5, 55.5.

HRMS (ESI) *m/z*: $[M + H]^+$ Calcd. for $C_{23}H_{18}NO_2^+$ 340.1332; Found 340.1349.

IR (KBr): 3848, 3525, 3411, 3047, 2999, 2924, 2847, 2659, 2324, 2080, 1902, 1780, 1711, 1670, 1596, 1513, 1458, 1422, 1370, 1339, 1306, 1268, 1232, 1163, 1033, 949, 903, 850, 819, 732, 675 cm^{-1}.

1-(9*H*-Carbazol-3-yl)-7-methoxynaphthalen-2-ol (6m)



The title compound **6m** was synthesized according to the **GP-2** and isolated after silica gel column chromatography (*n*-pentane : diethyl ether – 20:1 → 2:1) as a colorless solid (72%, 48.9 mg).

m.p.: 136 – 142 °C.

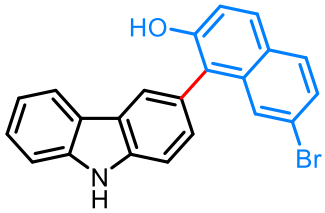
^{1}H NMR (600 MHz, $CDCl_3$): δ = 8.23 (br, 1H), 8.15 (s, 1H), 8.07 (d, *J* = 7.8 Hz, 1H), 7.77 – 7.74 (m, 2H), 7.63 (d, *J* = 8.2 Hz, 1H), 7.51 – 7.47 (m, 2H), 7.45 (d, *J* = 8.2 Hz, 1H), 7.28 (t, *J* = 7.5 Hz, 1H), 7.18 (d, *J* = 8.8 Hz, 1H), 7.01 (dd, *J* = 8.9, 2.4 Hz, 1H), 6.77 (d, *J* = 2.3 Hz, 1H), 5.29 (s, 1H), 3.63 (s, 3H) ppm.

^{13}C NMR (151 MHz, $CDCl_3$): δ = 158.4, 151.4, 140.0, 139.5, 135.4, 129.7, 129.2, 128.8, 126.6, 124.9, 124.7, 124.5, 123.1, 123.0, 121.1, 120.7, 120.1, 115.5, 114.9, 112.1, 111.0, 104.1, 55.2 ppm.

HRMS (ESI) *m/z*: $[M + Na]^+$ Calcd. for $C_{23}H_{17}NO_2Na^+$ 362.1152; Found 362.1149.

IR (KBr): 3855, 3509, 3408, 3055, 2930, 2834, 2668, 2251, 2077, 1895, 1732, 1618, 1511, 1491, 1459, 1376, 1332, 1267, 1221, 1157, 1032, 1003, 904, 829, 798, 728 cm^{-1}.

7-Bromo-1-(9*H*-carbazol-3-yl)naphthalen-2-ol (6n)



The title compound **6n** was synthesized according to the **GP-2** and isolated after silica gel column chromatography (*n*-pentane : diethyl ether – 20:1 → 2:1) as a colorless solid (67%, 52.0 mg).

m.p.: 178 – 180 °C.

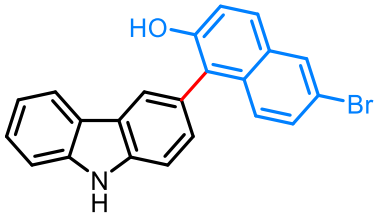
^{1}H NMR (600 MHz, $CDCl_3$): δ = 8.26 (br, 1H), 8.11 (s, 1H), 8.07 (d, *J* = 7.8 Hz, 1H), 7.80 (d, *J* = 8.9 Hz, 1H), 7.70 (d, *J* = 8.7 Hz, 1H), 7.66 (d, *J* = 8.2 Hz, 1H), 7.59 (s, 1H), 7.53 – 7.48 (m, 2H), 7.41 (d, *J* = 8.3 Hz, 2H), 7.32 (d, *J* = 8.9 Hz, 1H), 7.28 (t, *J* = 7.3 Hz, 1H), 5.36 (s, 1H) ppm.

^{13}C NMR (151 MHz, $CDCl_3$): δ = 151.7, 140.0, 139.6, 135.5, 129.8, 129.4, 128.7, 127.5, 127.2, 126.8, 126.7, 124.7, 123.8, 123.1, 123.0, 121.2, 121.1, 120.8, 120.2, 117.8, 112.2, 111.1 ppm.

HRMS (APCI) *m/z*: $[M]^+$ Calcd. for $C_{22}H_{14}NOBr^+$ 387.0253; Found 387.0241.

IR (KBr): 3850, 3503, 3412, 3054, 2923, 2665, 2326, 2111, 1892, 1710, 1609, 1494, 1445, 1359, 1330, 1239, 1198, 1161, 1067, 1043, 960, 903, 830, 728 cm^{-1}.

6-Bromo-1-(9*H*-carbazol-3-yl)naphthalen-2-ol (6o)



The title compound **6o** was synthesized according to the **GP-2** and isolated after silica gel column chromatography (*n*-pentane : diethyl ether – 20:1 → 2:1) as a colorless solid (73%, 56.6 mg).

m.p.: 189 – 195 °C.

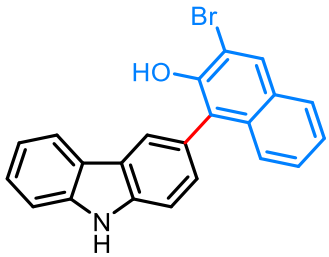
^{1}H NMR (400 MHz, $CDCl_3$): δ = 8.12 (br, 1H), 8.00 (s, 1H), 7.95 (d, *J* = 7.8 Hz, 1H), 7.89 (d, *J* = 1.3 Hz, 1H), 7.64 (d, *J* = 8.9 Hz, 1H), 7.51 (d, *J* = 8.2 Hz, 1H), 7.40 – 7.39 (m, 2H), 7.31 – 7.23 (m, 4H), 7.20 – 7.16 (m, 1H), 5.27 (s, 1H) ppm.

^{13}C NMR (101 MHz, $CDCl_3$): δ = 151.0, 139.9, 139.4, 132.6, 130.1, 129.9, 129.6, 128.5, 128.3, 126.9, 126.7, 124.5, 123.9, 122.9, 122.8, 121.9, 120.6, 120.1, 118.4, 117.0, 112.0, 110.9 ppm.

HRMS (ESI) *m/z*: $[M + H]^+$ Calcd. for $C_{22}H_{15}NOBr^+$ 388.0332; Found 388.0317.

IR (KBr): 3848, 3526, 3410, 3044, 2925, 2663, 2326, 2088, 1992, 1898, 1715, 1587, 1496, 1459, 1359, 1334, 1303, 1264, 1240, 1200, 1161, 1140, 1066, 942, 879, 849, 813, 732, 669 cm^{-1}.

3-Bromo-1-(9*H*-carbazol-3-yl)naphthalen-2-ol (6p)



The title compound **6p** was synthesized according to the **GP-2** and isolated after silica gel column chromatography (*n*-pentane : diethyl ether – 20:1 → 2:1) as a colorless solid (70%, 54.0 mg).

m.p.: 223 – 229 °C.

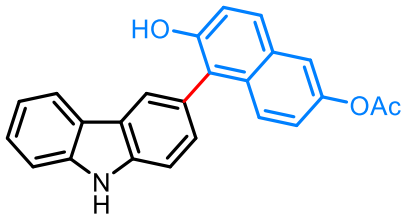
^{1}H NMR (600 MHz, $CDCl_3$): δ = 8.21 (br, 1H), 8.13 (d, *J* = 8.7 Hz, 2H), 8.05 (d, *J* = 7.8 Hz, 1H), 7.77 (d, *J* = 8.0 Hz, 1H), 7.62 (d, *J* = 8.2 Hz, 1H), 7.50 – 7.42 (m, 4H), 7.38 – 7.33 (m, 2H), 7.28 – 7.26 (m, 1H), 5.69 (s, 1H) ppm.

^{13}C NMR (151 MHz, $CDCl_3$): δ = 147.2, 140.0, 139.5, 133.5, 131.5, 129.7, 128.5, 127.2, 126.8, 126.6, 125.5, 124.8, 124.39, 124.36, 123.6, 123.1, 122.9, 120.7, 120.1, 111.8, 111.7, 111.0 ppm.

HRMS (ESI) *m/z*: $[M + Na]^+$ Calcd. for $C_{22}H_{14}NOBrNa^+$ 410.0151; Found 410.0151.

IR (KBr): 3847, 3511, 3415, 3052, 2922, 2853, 2665, 2326, 2111, 1897, 1767, 1602, 1579, 1497, 1451, 1376, 1331, 1265, 1239, 1202, 1142, 1005, 949, 882, 821, 739 cm^{-1}.

5-(9*H*-Carbazol-3-yl)-6-hydroxynaphthalen-2-yl acetate (6q)



The title compound **6q** was synthesized according to the **GP-2** and isolated after silica gel column chromatography (*n*-pentane : diethyl ether – 20:1 → 2:1) as a colorless solid (58%, 42.5 mg).

m.p.: 121 – 126 °C.

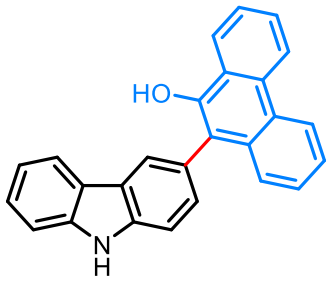
^{1}H NMR (600 MHz, $CDCl_3$): δ = 8.28 (br, 1H), 8.10 (s, 1H), 8.05 (d, *J* = 7.8 Hz, 1H), 7.78 (d, *J* = 8.9 Hz, 1H), 7.57 – 7.56 (m, 2H), 7.47 – 7.46 (m, 3H), 7.38 (dd, *J* = 8.2, 1.6 Hz, 1H), 7.33 (d, *J* = 8.9 Hz, 1H), 7.28 – 7.25 (m, 1H), 7.07 (dd, *J* = 9.1, 2.4 Hz, 1H), 5.33 (s, 1H), 2.35 (s, 3H) ppm.

^{13}C NMR (151 MHz, $CDCl_3$): δ = 170.2, 150.8, 146.6, 140.0, 139.5, 132.3, 129.2, 128.9, 128.7, 126.7, 126.6, 124.5, 124.3, 123.1, 123.0, 122.1, 121.5, 120.7, 120.1, 118.8, 118.3, 112.0, 111.0, 21.3 ppm.

HRMS (ESI) *m/z*: $[M + Na]^+$ Calcd. for $C_{24}H_{17}NO_3Na^+$ 390.1101; Found 390.1088.

IR (KBr): 3511, 3406, 3056, 2929, 2251, 2110, 1899, 1742, 1602, 1513, 1492, 1418, 1335, 1203, 1146, 1044, 1013. 960, 904, 814, 728, 671 cm^{-1}.

10-(9*H*-Carbazol-3-yl)phenanthren-9-ol (6r)



The title compound **6r** was synthesized according to the **GP-2** and isolated after silica gel column chromatography (*n*-pentane : diethyl ether – 20:1 → 2:1) as a colorless solid (52%, 37.5 mg).

m.p.: 210 – 218 °C.

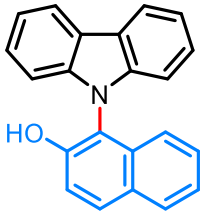
^{1}H NMR (600 MHz, $CDCl_3$): δ = 8.77 (d, *J* = 8.2 Hz, 1H), 8.73 (d, *J* = 8.2 Hz, 1H), 8.45 (dd, *J* = 8.0, 0.9 Hz, 1H), 8.20 (s, 2H), 8.06 (d, *J* = 7.8 Hz, 1H), 7.75 (t, *J* = 7.6 Hz, 1H), 7.71 (t, *J* = 7.5 Hz, 1H), 7.63 (d, *J* = 8.1 Hz, 1H), 7.53 (t, *J* = 7.5 Hz, 1H), 7.49 – 7.48 (m, 4H), 7.43 (t, *J* = 8.0 Hz, 1H), 7.29 – 7.27 (m, 1H), 5.69 (s, 1H) ppm.

^{13}C NMR (151 MHz, $CDCl_3$): δ = 146.7, 140.0, 139.5, 133.4, 131.1, 129.1, 127.3, 126.9, 126.8, 126.6, 126.5, 125.8, 125.2, 124.9, 124.7, 124.0, 123.4, 123.2, 123.1, 122.7, 120.7, 120.1, 112.1, 111.0 ppm.

HRMS (APCI) *m/z*: $[M + H]^+$ Calcd. for $C_{26}H_{18}NO^+$ 360.1383; Found 360.1392.

IR (KBr): 3515, 3416, 3064, 2925, 2329, 2248, 2122, 1685, 1600, 1491, 1448, 1400, 1338, 1295, 1238, 1211, 1154, 1131, 1108, 1065, 1041, 948, 904, 811, 726 cm^{-1}.

1-(9*H*-Carbazol-9-yl)naphthalen-2-ol (7a)



The title compound **7a** was synthesized according to the **GP-3** and isolated after silica gel column chromatography (*n*-pentane : diethyl ether – 20:1 → 4:1) as a colorless solid (91%, 56.5 mg).

m.p.: 130 – 133 °C.

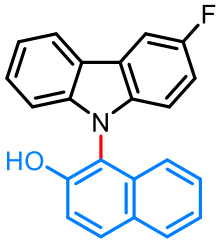
^{1}H NMR (600 MHz, $CDCl_3$): δ = 8.26 (d, *J* = 7.4 Hz, 2H), 8.03 (d, *J* = 9.0 Hz, 1H), 7.95 (d, *J* = 8.1 Hz, 1H), 7.49 (d, *J* = 9.0 Hz, 1H), 7.42 – 7.37 (m, 5H), 7.26 (t, *J* = 7.7 Hz, 1H), 7.02 (d, *J* = 7.6 Hz, 2H), 6.85 (d, *J* = 8.4 Hz, 1H), 5.35 (s, 1H) ppm.

^{13}C NMR (151 MHz, $CDCl_3$): δ = 151.7, 141.2, 131.9, 131.1, 129.8, 128.5, 127.7, 126.6, 124.3, 123.9, 122.0, 120.7, 120.6, 117.9, 115.3, 110.4 ppm.

HRMS (APCI) *m/z*: $[M]^+$ Calcd. for $C_{22}H_{15}NO^+$ 309.1148; Found 309.1146.

IR (KBr): 3480, 3055, 2926, 2673, 2320, 2111, 1898, 1775, 1701, 1623, 1599, 1514, 1475, 1447, 1402, 1337, 1311, 1264, 1226, 1193, 1138, 1068, 1020, 970, 927, 859, 816, 744 cm^{-1}.

1-(3-Fluoro-9*H*-carbazol-9-yl)naphthalen-2-ol (7b)



The title compound **7b** was synthesized according to the **GP-3** and isolated after silica gel column chromatography (*n*-pentane : diethyl ether – 20:1 → 4:1) as a colorless solid (81%, 53.3 mg).

m.p.: 115 – 117 °C.

^{1}H NMR (400 MHz, $CDCl_3$): δ = 8.08 (d, *J* = 7.8 Hz, 1H), 7.91 (d, *J* = 9.0 Hz, 1H), 7.83 (d, *J* = 8.1 Hz, 1H), 7.78 (dd, *J* = 8.8, 2.4 Hz, 1H), 7.36 (d, *J* = 9.0 Hz, 1H), 7.31 – 7.22 (m, 3H), 7.17 – 7.13 (m, 1H), 7.01 (td, *J* = 9.0, 2.5 Hz, 1H), 6.88 (d, *J* = 7.9 Hz, 1H), 6.80 (dd, *J* = 8.8, 4.2 Hz, 1H), 6.66 (d, *J* = 8.4 Hz, 1H), 5.21 (s, 1H) ppm.

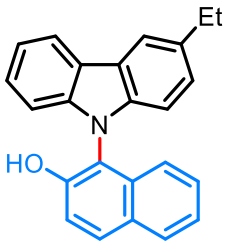
^{13}C NMR (101 MHz, $CDCl_3$): δ = 158.4 (d, *J* = 237.4 Hz), 151.8, 142.1, 137.5, 131.8, 131.3, 129.8, 128.6, 127.8, 127.2, 124.5, 124.4, 123.5 (d, *J* = 4.1 Hz), 121.8, 120.9, 120.7, 117.9, 115.1, 114.3 (d, *J* = 25.5 Hz), 111.1 (d, *J* = 9.1 Hz), 110.7, 106.6 (d, *J* = 24.1 Hz) ppm.

^{19}F NMR (565 MHz, Chloroform-*d*): δ = -122.91 – -122.94 (m) ppm.

HRMS (APCI) *m/z*: $[M + H]^+$ Calcd. for $C_{22}H_{15}NOF^+$ 328.1132; Found 328.1124.

IR (KBr): 3487, 3060, 2671, 2326, 2083, 1902, 1711, 1626, 1600, 1516, 1479, 1453, 1402, 1339, 1270, 1193, 1167, 1141, 1042, 972, 908, 866, 809, 734 cm^{-1}.

1-(3-Ethyl-9*H*-carbazol-9-yl)naphthalen-2-ol (7c)



The title compound **7c** was synthesized according to the **GP-3** and isolated after silica gel column chromatography (*n*-pentane : diethyl ether – 20:1 → 4:1) as a colorless solid (90%, 60.8 mg).

m.p.: 138 – 144 °C.

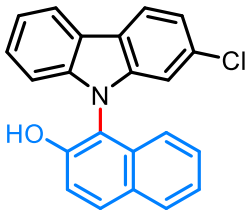
^{1}H NMR (400 MHz, $CDCl_3$): δ = 8.12 – 8.10 (m, 1H), 7.95 (s, 1H), 7.88 (d, *J* = 9.0 Hz, 1H), 7.81 (d, *J* = 8.1 Hz, 1H), 7.34 (d, *J* = 9.0 Hz, 1H), 7.27 – 7.21 (m, 3H), 7.15 – 7.10 (m, 2H), 6.86 – 6.84 (m, 1H), 6.79 (d, *J* = 8.3 Hz, 1H), 6.71 (d, *J* = 8.4 Hz, 1H), 5.21 (s, 1H), 2.77 (q, *J* = 7.6 Hz, 2H), 1.28 (t, *J* = 7.6 Hz, 3H) ppm.

^{13}C NMR (101 MHz, $CDCl_3$): δ = 151.8, 141.5, 139.7, 136.9, 131.9, 131.0, 129.8, 128.5, 127.6, 126.9, 126.4, 124.2, 124.0, 123.9, 122.1, 120.6, 120.5, 119.5, 117.9, 115.5, 110.4, 110.2, 29.1, 16.6 ppm.

HRMS (ESI) *m/z*: $[M + Na]^+$ Calcd. for $C_{24}H_{19}NONa^+$ 360.1359; Found 360.1372.

IR (KBr): 3477, 3055, 2962, 2928, 2867, 2670, 2249, 2051, 1893, 1717, 1625, 1601, 1480, 1456, 1402, 1334, 1263, 1229, 1200, 1139, 1046, 971, 908, 882, 813, 772, 741, 664 cm^{-1}.

1-(2-Chloro-9*H*-carbazol-9-yl)naphthalen-2-ol (7d)



The title compound **7d** was synthesized according to the **GP-3** and isolated after silica gel column chromatography (*n*-pentane : diethyl ether – 20:1 → 4:1) as a colorless solid (83%, 57.1 mg).

m.p.: 114 – 117 °C.

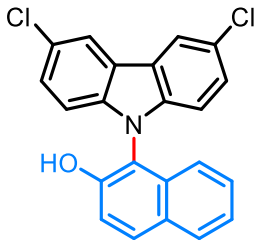
^{1}H NMR (600 MHz, $CDCl_3$): δ = 8.17 (d, *J* = 7.5 Hz, 1H), 8.11 (d, *J* = 8.3 Hz, 1H), 8.01 (d, *J* = 9.0 Hz, 1H), 7.93 (d, *J* = 8.2 Hz, 1H), 7.44 (d, *J* = 9.0 Hz, 1H), 7.39 – 7.34 (m, 3H), 7.31 (d, *J* = 8.3 Hz, 1H), 7.27 – 7.24 (m, 1H), 6.97 – 6.96 (m, 2H), 6.77 (d, *J* = 8.5 Hz, 1H), 5.24 (s, 1H) ppm.

^{13}C NMR (151 MHz, $CDCl_3$): δ = 151.6, 141.8, 141.5, 132.4, 131.6, 131.3, 129.7, 128.5, 127.8, 126.8, 124.3, 123.2, 122.4, 121.6, 121.4, 121.3, 121.1, 120.5, 117.8, 114.5, 110.43, 110.38 ppm.

HRMS (ESI) *m/z*: $[M + H]^+$ Calcd. for $C_{22}H_{15}NOCl^+$ 344.0837; Found 344.0844.

IR (KBr): 3485, 3410, 3061, 2970, 2920, 2859, 2669, 2250, 2099, 1899, 1708, 1624, 1596, 1434, 1401, 1333, 1270, 1227, 1194, 1139, 1068, 973, 941, 907, 849, 814, 730 cm^{-1}.

1-(3,6-Dichloro-9*H*-carbazol-9-yl)naphthalen-2-ol (7e)



The title compound **7e** was synthesized according to the **GP-3** and isolated after silica gel column chromatography (*n*-pentane : diethyl ether – 20:1 → 4:1) as a colorless solid (82%, 62.2 mg).

m.p.: 130 – 134 °C.

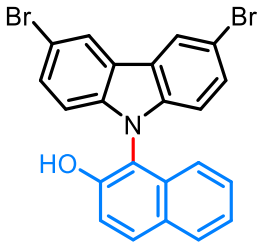
^{1}H NMR (400 MHz, $CDCl_3$): δ = 8.00 (d, *J* = 1.9 Hz, 2H), 7.87 (d, *J* = 9.0 Hz, 1H), 7.79 (d, *J* = 8.1 Hz, 1H), 7.29 (d, *J* = 9.0 Hz, 1H), 7.25 (t, *J* = 7.5 Hz, 1H), 7.21 (d, *J* = 1.9 Hz, 1H), 7.19 (d, *J* = 1.9 Hz, 1H), 7.12 (t, *J* = 7.6 Hz, 1H), 6.76 (d, *J* = 8.7 Hz, 2H), 6.58 (d, *J* = 8.4 Hz, 1H), 5.17 (s, 1H) ppm.

^{13}C NMR (101 MHz, $CDCl_3$): δ = 151.7, 140.1, 131.6, 129.8, 128.7, 128.0, 127.3, 126.7, 124.5, 124.0, 121.5, 120.7, 117.9, 114.5, 111.7 ppm.

HRMS (APCI) *m/z*: $[M + H]^+$ Calcd. for $C_{22}H_{14}NOCl_2^+$ 378.0447; Found 378.0441.

IR (KBr): 3486, 3060, 2925, 2663, 2252, 2081, 1842, 1730, 1624, 1601, 1515, 1471, 1436, 1402, 1343, 1317, 1276, 1227, 1194, 1134, 1071, 1023, 972, 907, 863, 801, 730, 665 cm^{-1}.

1-(3,6-Dibromo-9*H*-carbazol-9-yl)naphthalen-2-ol (7f)



The title compound **7f** was synthesized according to the **GP-3** and isolated after silica gel column chromatography (*n*-pentane : diethyl ether – 20:1 → 4:1) as a colorless solid (85%, 79.4 mg).

m.p.: 155 – 158 °C.

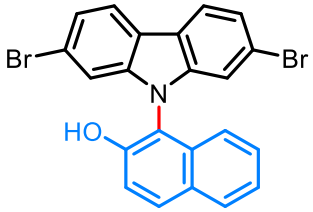
^{1}H NMR (600 MHz, $CDCl_3$): δ = 8.15 (s, 2H), 7.86 (d, *J* = 9.0 Hz, 1H), 7.78 (d, *J* = 8.1 Hz, 1H), 7.32 (dd, *J* = 8.6, 1.7 Hz, 2H), 7.27 (d, *J* = 9.0 Hz, 1H), 7.23 (t, *J* = 7.5 Hz, 1H), 7.12 – 7.09 (m, 1H), 6.70 (d, *J* = 8.6 Hz, 2H), 6.55 (d, *J* = 8.5 Hz, 1H), 5.11 (s, 1H) ppm.

^{13}C NMR (151 MHz, $CDCl_3$): δ = 151.6, 140.3, 131.6, 131.5, 130.1, 129.8, 128.7, 128.0, 124.6, 124.5, 123.7, 121.5, 117.9, 114.4, 114.1, 112.1 ppm.

HRMS (APCI) *m/z*: $[M + H]^+$ Calcd. for $C_{22}H_{14}NOBr_2^+$ 465.9437; Found 465.9425.

IR (KBr): 3502, 3064, 2925, 2249, 2111, 1868, 1734, 1625, 1603, 1515, 1467, 1432, 1403, 1343, 1315, 1277, 1227, 1193, 1140, 1054, 1021, 970, 906, 867, 806, 729 cm^{-1}.

1-(2,7-Dibromo-9*H*-carbazol-9-yl)naphthalen-2-ol (7g)



The title compound **7g** was synthesized according to the **GP-3** and isolated after silica gel column chromatography (*n*-pentane : diethyl ether – 20:1 → 4:1) as a colorless solid (86%, 80.1 mg).

m.p.: 226 – 228 °C

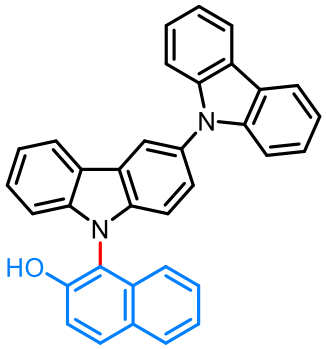
^{1}H NMR (600 MHz, $CDCl_3$): δ = 8.03 – 8.00 (m, 3H), 7.94 (d, *J* = 8.2 Hz, 1H), 7.45 (dd, *J* = 8.3, 1.4 Hz, 2H), 7.43 (d, *J* = 9.0 Hz, 1H), 7.40 (t, *J* = 7.5 Hz, 1H), 7.28 (t, *J* = 7.6 Hz, 1H), 7.09 (d, *J* = 1.4 Hz, 2H), 6.73 (d, *J* = 8.4 Hz, 1H), 5.21 (s, 1H) ppm.

^{13}C NMR (151 MHz, $CDCl_3$): δ = 151.7, 142.2, 131.8, 131.5, 129.8, 128.7, 128.2, 124.6, 124.5, 122.2, 121.9, 121.4, 120.7, 118.0, 114.0, 113.6 ppm.

HRMS (APCI) *m/z*: $[M + H]^+$ Calcd. for $C_{22}H_{14}NOBr_2^+$ 465.9437; Found 465.9436.

IR (KBr): 3875, 3481, 3399, 3062, 2922, 2853, 2659, 2326, 2108, 1993, 1900, 1700, 1623, 1587, 1518, 1480, 1421, 1326, 1272, 1224, 1198, 1138, 1050, 1000, 972, 944, 903, 851, 802, 725 cm^{-1}.

1-(9*H*-[3,9'-Bicarbazol]-9-yl)naphthalen-2-ol (7h)



The title compound **7h** was synthesized according to the **GP-3** and isolated after silica gel column chromatography (*n*-pentane : diethyl ether – 20:1 → 4:1) as a colorless solid (73%, 69.2 mg).

m.p.: 189 – 192 °C.

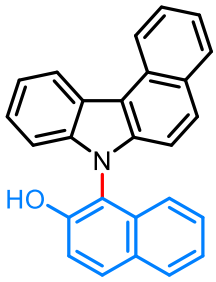
^{1}H NMR (600 MHz, $CDCl_3$): δ = 8.38 (s, 1H), 8.21 – 8.19 (m, 3H), 8.04 (d, *J* = 9.0 Hz, 1H), 7.96 (d, *J* = 8.2 Hz, 1H), 7.52 (d, *J* = 8.5 Hz, 1H), 7.50 (d, *J* = 9.0 Hz, 1H), 7.46 – 7.41 (m, 6H), 7.38 (t, *J* = 7.4 Hz, 1H), 7.35 – 7.30 (m, 3H), 7.18 (d, *J* = 8.5 Hz, 1H), 7.06 (d, *J* = 8.2 Hz, 1H), 6.95 (d, *J* = 8.4 Hz, 1H), 5.34 (s, 1H) ppm.

^{13}C NMR (151 MHz, $CDCl_3$): δ = 151.7, 141.8, 141.7, 140.2, 131.7, 130.7, 129.8, 128.6, 127.8, 127.2, 126.0, 125.9, 124.8, 124.4, 123.4, 123.2, 121.8, 121.1, 120.9, 120.3, 119.74, 119.70, 117.8, 114.9, 111.3, 110.6, 109.8 ppm.

HRMS (ESI) *m/z*: $[M + H]^+$ Calcd. for $C_{34}H_{23}N_2O^+$ 475.1805; Found 475.1822.

IR (KBr): 3493, 3053, 2925, 2670, 2248, 2049, 1894, 1707, 1624, 1598, 1484, 1453, 1404, 1315, 1270, 1229, 1193, 1140, 1022, 970, 906, 814, 725 cm^{-1}.

1-(7*H*-Benzo[*c*]carbazol-7-yl)naphthalen-2-ol (7i)



The title compound **7i** was synthesized according to the **GP-3** and isolated after silica gel column chromatography (*n*-pentane : diethyl ether – 20:1 → 4:1) as a colorless solid (86%, 62 mg).

m.p.: 184 – 190 °C.

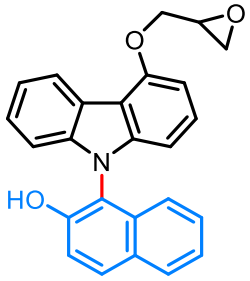
^{1}H NMR (400 MHz, $CDCl_3$): δ = 8.92 (d, *J* = 8.3 Hz, 1H), 8.73 (d, *J* = 8.0 Hz, 1H), 8.05 – 8.02 (m, 2H), 7.94 (d, *J* = 8.2 Hz, 1H), 7.82 – 7.78 (m, 2H), 7.55 (t, *J* = 7.5 Hz, 1H), 7.51 7.47 (m, 2H), 7.43 – 7.35 (m, 2H), 7.21 (t, *J* = 7.7 Hz, 1H), 7.17 (d, *J* = 8.8 Hz, 1H), 7.13 (d, *J* = 8.1 Hz, 1H), 6.75 (d, *J* = 8.5 Hz, 1H), 5.33 (s, 1H) ppm.

^{13}C NMR (101 MHz, $CDCl_3$): δ = 151.9, 140.4, 139.2, 132.1, 131.3, 130.0, 129.9, 129.8, 129.5, 128.5, 128.2, 127.9, 127.4, 125.2, 124.6, 124.4, 123.7, 123.5, 122.5, 121.9, 121.5, 117.9, 116.4, 115.2, 111.9, 110.9 ppm.

HRMS (ESI) *m/z*: $[M + H]^+$ Calcd. for $C_{26}H_{18}NO^+$ 360.1383; Found 360.1395.

IR (KBr): 3855, 3484, 3055, 2924, 2669, 2248, 2111, 1923, 1805, 1701, 1622, 1519, 1466, 1404, 1342, 1321, 1273, 1211, 1139, 1089, 1018, 959, 905, 850, 807, 731, 680 cm^{-1}.

1-(4-(Oxiran-2-ylmethoxy)-9*H*-carbazol-9-yl)naphthalen-2-ol (7j)



The title compound **7j** was synthesized according to the **GP-3** and isolated after silica gel column chromatography (*n*-pentane : diethyl ether – 20:1 → 4:1) as a colorless solid (68%, 51.7 mg).

m.p.: 175 – 179 °C.

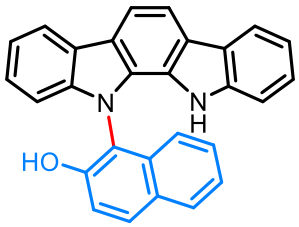
^{1}H NMR (600 MHz, $CDCl_3$): δ = 8.49 (d, *J* = 6.6 Hz, 1H), 7.99 (d, *J* = 9.0 Hz, 1H), 7.91 (d, *J* = 8.1 Hz, 1H), 7.44 (d, *J* = 9.0 Hz, 1H), 7.37 – 7.34 (m, 3H), 7.27 – 7.26 (m, 1H), 7.24 – 7.21 (m, 1H), 6.95 (d, *J* = 7.2 Hz, 1H), 6.81 – 6.77 (m, 2H), 6.62 (d, *J* = 8.1 Hz, 1H), 5.34 (s, 1H), 4.57 – 4.55 (m, 1H), 4.35 – 3.31 (m, 1H), 3.613 – 3.612 (m, 1H), 3.05 – 3.03 (m, 1H), 2.95 – 2.94 (m, 1H) ppm.

^{13}C NMR (151 MHz, $CDCl_3$): δ = 155.2, 151.63, 151.60, 142.6, 140.4, 131.7, 131.0, 129.6, 128.4, 127.6, 127.5, 127.2, 125.7, 124.2, 124.1, 123.5, 123.0, 121.91, 121.90, 121.0, 117.78, 117.76, 115.3, 113.3, 109.7, 103.6, 102.6, 69.0, 50.4, 44.9 ppm.

HRMS (ESI) *m/z*: $[M + H]^+$ Calcd. for $C_{25}H_{20}NO_3^+$ 382.1438; Found 382.1429.

IR (KBr): 3381, 3058, 2923, 2247, 2105, 1900, 1708, 1623, 1593, 1506, 1478, 1447, 1401, 1345, 1315, 1271, 1204, 1174, 1142, 1109, 1056, 1017, 968, 906, 855, 815, 780, 722 cm^{-1}.

8-(Indolo[2,3-*a*]carbazol-11(12*H*)-yl)naphthalen-2-ol (7k)



The title compound **7k** was synthesized according to the **GP-3** and isolated after silica gel column chromatography (*n*-pentane : diethyl ether – 20:1 → 4:1) as a colorless solid (42%, 33.4 mg).

m.p.: 207 – 210 °C.

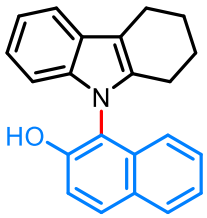
^{1}H NMR (600 MHz, $CDCl_3$): δ = 8.29 (d, *J* = 7.6 Hz, 1H), 8.14 (d, *J* = 9.0 Hz, 1H), 8.11 – 8.08 (m, 2H), 8.06 – 8.05 (m, 1H), 7.98 (d, *J* = 8.2 Hz, 1H), 7.56 (d, *J* = 9.1 Hz, 1H), 7.40 – 7.36 (m, 3H), 7.28 (t, *J* = 7.6 Hz, 1H), 7.22 – 7.19 (m, 2H), 7.13 – 7.12 (m, 2H), 7.03 (d, *J* = 7.7 Hz, 1H), 6.88 (d, *J* = 8.5 Hz, 1H), 5.60 (s, 1H) ppm.

^{13}C NMR (151 MHz, $CDCl_3$): δ = 152.2, 140.8, 139.1, 132.4, 131.9, 129.5, 128.6, 128.5, 127.1, 125.9, 125.6, 125.3, 125.2, 124.9, 123.8, 122.7, 122.1, 121.9, 121.2, 120.5, 120.1, 119.9, 117.9, 116.5, 113.6, 112.6, 111.1, 110.3 ppm.

HRMS (ESI) *m/z*: $[M + H]^+$ Calcd. for $C_{28}H_{19}N_2OF$ 399.1492; Found 399.1482.

IR (KBr): 3851, 3451, 3056, 2921, 2852, 2684, 2324, 2240, 2174, 2103, 2012, 1924, 1737, 1622, 1598, 1567, 1512, 1438, 1407, 1372, 1317, 1265, 1212, 1184, 1140, 1013, 964, 904, 859, 815, 731 cm^{-1}.

1-(1,2,3,4-Tetrahydro-9*H*-carbazol-9-yl)naphthalen-2-ol (7l)



The title compound **7l** was synthesized according to the **GP-3** and isolated after silica gel column chromatography (*n*-pentane : diethyl ether – 20:1 → 4:1) as a colorless solid (36%, 22.5 mg).

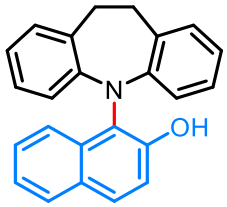
^{1}H NMR (400 MHz, $CDCl_3$): δ = 7.91 (d, *J* = 9.0 Hz, 1H), 7.86 (d, *J* = 8.5 Hz, 1H), 7.62 (d, *J* = 7.8 Hz, 1H), 7.38 – 7.28 (m, 3H), 7.18 (t, *J* = 7.4 Hz, 1H), 7.07 (t, *J* = 7.6 Hz, 1H), 6.84 – 6.81 (m, 2H), 5.36 (s, 1H), 2.93 – 2.80 (m, 2H), 2.42 – 2.35 (m, 1H), 2.30 – 7.23 (m, 1H), 1.96 – 1.90 (m, 2H), 1.88 – 1.82 (m, 2H) ppm.

^{13}C NMR (151 MHz, $CDCl_3$): δ = 151.5, 137.7, 137.4, 132.7, 130.6, 129.4, 128.5, 128.3, 127.7, 124.1, 121.9, 121.9, 120.3, 118.2, 117.5, 116.3, 112.4, 110.2, 23.3, 23.2, 22.2, 21.3 ppm.

HRMS (ESI) *m/z*: $[M + H]^+$ Calcd. for $C_{22}H_{20}NO^+$ 314.1539; Found 314.1546.

IR (KBr): 3844, 3512, 3412, 3057, 2925, 2855, 2665, 2491, 2249, 2103, 1895, 1704, 1598, 1511, 1461, 1387, 1330, 1268, 1238, 1203, 1169, 1142, 1052, 985, 949, 902, 811, 727 cm^{-1}.

1-(10,11-Dihydro-5*H*-dibenzo[b,f]azepin-5-yl)naphthalen-2-ol (7m)



The title compound **7m** was synthesized according to the **GP-3** and isolated after silica gel column chromatography (*n*-pentane : diethyl ether – 20:1 → 4:1) as a colorless solid (79%, 53.1 mg).

m.p.: 119 – 122 °C.

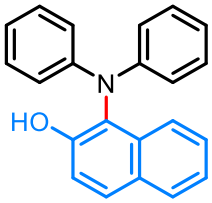
^{1}H NMR (600 MHz, $CDCl_3$): δ = 7.90 – 7.86 (m, 2H), 7.68 – 7.67 (m, 1H), 7.39 – 7.34 (m, 3H), 7.14 (d, *J* = 7.2 Hz, 2H)), 6.85 – 6.80 (m, 4H), 6.53 (d, *J* = 8.1, 2H), 5.81 (s, 1H), 3.36 (s, 4H) ppm.

^{13}C NMR (151 MHz, $CDCl_3$): δ = 151.6, 143.9, 132.3, 132.2, 130.8, 130.3, 130.0, 128.7, 127.6, 127.2, 125.3, 124.1, 122.9, 121.2, 120.5, 118.0, 37.5 ppm.

HRMS (ESI) *m/z*: $[M + H]^+$ Calcd. for $C_{24}H_{20}NO^+$ 338.1539; Found 338.1532.

IR (KBr): 3498, 3458, 3060, 3020, 2920, 2853, 2329, 2108, 1900, 1622, 1592, 1482, 1441, 1384, 1297, 1261, 1190, 1133, 1114, 1063, 962, 941, 904, 863, 815, 741 cm^{-1}.

1-(Diphenylamino)naphthalen-2-ol (7n)



The title compound **7n** was synthesized according to the **GP-3** and isolated after silica gel column chromatography (*n*-pentane : diethyl ether – 20:1 → 4:1) as a colorless solid (77%, 48.0 mg).

m.p.: 163 – 167 °C.

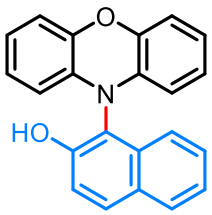
^{1}H NMR (600 MHz, $CDCl_3$): δ = 7.85 -7.82 (m, 2H), 7.74 (d, *J* = 7.8 Hz, 1H), 7.37 – 7.31 (m, 3H), 7.23 (t, *J* = 7.8 Hz, 4H), 7.13 (d, *J* = 8.0 Hz, 4H), 6.97 (t, *J* = 7.3 Hz, 2H), 5.91 (s, 1H) ppm.

^{13}C NMR (151 MHz, $CDCl_3$): δ = 151.9, 146.1, 132.7, 130.3, 129.7, 129.6, 128.6, 127.4, 124.0, 123.9, 122.8, 122.4, 120.4, 118.1 ppm.

HRMS (ESI) *m/z*: $[M + H]^+$ Calcd. for $C_{22}H_{18}NO^+$ 312.1383; Found 312.1390.

IR (KBr): 3511, 3463, 3374, 3057, 2923, 2854, 2325, 2160, 2108, 1799, 1587, 1489, 1385, 1297, 1200, 1175, 1139, 1077, 1025, 962, 905, 863, 812, 780, 747, 692 cm^{-1}.

1-(10*H*-Phenoxazin-10-yl)naphthalen-2-ol (7o)



The title compound **7o** was synthesized according to the **GP-3** and isolated after silica gel column chromatography (*n*-pentane : diethyl ether – 20:1 → 4:1) as a colorless solid (48%, 31.3 mg).

m.p.: 108 – 110 °C.

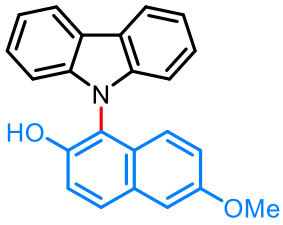
^{1}H NMR (600 MHz, $CDCl_3$): δ = 7.93 (d, *J* = 8.9 Hz, 1H), 7.89 (d, *J* = 7.5 Hz, 1H), 7.80 (d, *J* = 8.0 Hz, 1H), 7.42 – 7.37 (m, 3H), 6.81 (d, *J* = 7.8 Hz, 2H), 6.73 – 7.68 (m, 2H), 6.56 (t, *J* = 7.8 Hz, 2H), 6.17 (s, 1H), 5.85 (d, *J* = 7.7 Hz, 2H) ppm.

^{13}C NMR (151 MHz, $CDCl_3$): δ = 144.4, 131.1, 130.6, 129.0, 127.8, 124.2, 124.0, 122.6, 122.4, 117.8, 116.1, 116.0, 113.8 ppm.

HRMS (ESI) *m/z*: $[M + H]^+$ Calcd. for $C_{22}H_{16}NO_2^+$ 326.1176; Found 326.1169.

IR (KBr): 3822, 3413, 3059, 2923, 2853, 2612, 2324, 2166, 2066, 1990, 1915, 1745, 1623, 1597, 1482, 1391, 1326, 1270, 1188, 1135, 1068, 1038, 967, 915, 863, 818, 731 cm^{-1}.

1-(9*H*-Carbazol-9-yl)-6-methoxynaphthalen-2-ol (7p)



The title compound **7p** was synthesized according to the **GP-3** and isolated after silica gel column chromatography (*n*-pentane : diethyl ether – 20:1 → 4:1) as a colorless solid (88%, 59.9 mg).

m.p.: 170 – 173 °C.

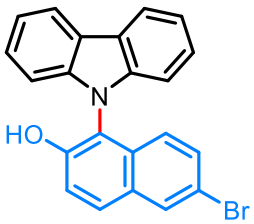
^{1}H NMR (600 MHz, $CDCl_3$): δ = 8.22 (d, *J* = 7.6 Hz, 2H), 7.88 (d, *J* = 9.0 Hz, 1H), 7.43 (d, *J* = 9.0 Hz, 1H), 7.42 – 7.39 (m, 4H), 7.24 (s, 1H), 7.00 (d, *J* = 7.9 Hz, 2H), 6.91 (d, *J* = 9.2 Hz, 1H), 6.73 (d, *J* = 9.2 Hz, 1H), 5.21 (s, 1H), 3.88 (s, 3H) ppm.

^{13}C NMR (151 MHz, $CDCl_3$): δ = 156.6, 150.0, 141.2, 130.8, 129.6, 127.1, 126.6, 123.8, 123.6, 120.69, 120.66, 120.1, 118.4, 115.6, 110.4, 107.0, 55.5 ppm.

HRMS (ESI) *m/z*: $[M + H]^+$ Calcd. for $C_{23}H_{18}NO_2^+$ 340.1332; Found 340.1343.

IR (KBr): 3482, 3056, 2937, 2838, 2675, 2249, 2061, 1900, 1777, 1603, 1517, 1478, 1449, 1384, 1336, 1312, 1232, 1195, 1135, 1073, 1029, 974, 945, 906, 851, 817, 726, 679 cm^{-1}.

6-Bromo-1-(9*H*-carbazol-9-yl)naphthalen-2-ol (7q)



The title compound **7q** was synthesized according to the **GP-3** and isolated after silica gel column chromatography (*n*-pentane : diethyl ether – 20:1 → 4:1) as a colorless solid (79%, 61.0 mg).

m.p.: 119 – 123 °C.

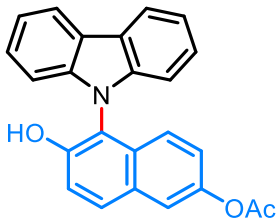
^{1}H NMR (600 MHz, $CDCl_3$): δ = 8.22 (d, *J* = 8.3 Hz, 2H), 8.08 (d, *J* = 1.8 Hz, 1H), 7.90 (d, *J* = 9.0 Hz, 1H), 7.47 (d, *J* = 9.1 Hz, 1H), 7.39 – 7.34 (m, 4H), 7.29 (dd, *J* = 9.0, 1.9 Hz, 1H), 6.95 (d, J = 7.6 Hz, 2H), 6.68 (d, *J* = 9.0 Hz, 1H), 5.35 (s, 1H) ppm.

^{13}C NMR (151 MHz, $CDCl_3$): δ = 151.9, 140.9, 130.8, 130.7, 130.4, 130.3, 130.0, 126.6, 123.8, 123.7, 120.8, 120.7, 119.0, 118.0, 115.4, 110.1 ppm.

HRMS (ESI) *m/z*: $[M + H]^+$ Calcd. for $C_{22}H_{15}NOBr^+$ 388.0332; Found 388.0329.

IR (KBr): 3838, 3451, 3053, 2925, 2672, 2327, 2110, 1991, 1901, 1772, 1619, 1590, 1474, 1447, 1378, 1334, 1262, 1226, 1192, 1141, 1072, 1019, 973, 905, 846, 813, 723 cm^{-1}.

5-(9*H*-Carbazol-9-yl)-6-hydroxynaphthalen-2-yl acetate (7r)



The title compound **7r** was synthesized according to the **GP-3** and isolated after silica gel column chromatography (*n*-pentane : diethyl ether – 20:1 → 4:1) as a colorless solid (72%, 53.0 mg).

m.p.: 169 – 172 °C.

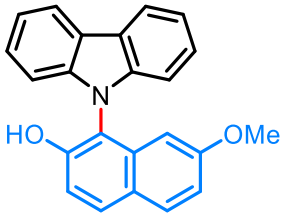
^{1}H NMR (600 MHz, $CDCl_3$): δ = 8.22 – 8.21 (m, 2H), 7.93 (d, *J* = 9.0 Hz, 1H), 7.63 (d, *J* = 2.3 Hz, 1H), 7.46 (d, *J* = 9.0 Hz, 1H), 7.38 – 7.32 (m, 4H), 6.97 – 6.94 (m, 3H), 6.80 (d, *J* = 9.1 Hz, 1H), 5.37 (s, 1H), 2.30 (s, 3H) ppm.

^{13}C NMR (151 MHz, $CDCl_3$): δ = 169.8, 151.7, 147.3, 141.1, 130.7, 130.0, 129.9, 126.7, 123.9, 123.7, 122.7, 120.8, 120.7, 119.4, 118.9, 115.5, 110.4, 21.29 ppm.

HRMS (ESI) *m/z*: $[M + Na]^+$ Calcd. for $C_{24}H_{17}NO_3Na^+$ 390.1101; Found 390.1086.

IR (KBr): 3417, 3055, 2925, 2675, 2316, 2106, 1904, 1748, 1602, 1516, 1480, 1450, 1391, 1367, 1338, 1312, 1195, 1138, 1011, 961, 910, 886, 818, 749, 727 cm^{-1}.

1-(9*H*-Carbazol-9-yl)-7-methoxynaphthalen-2-ol (7s)



The title compound **7s** was synthesized according to the **GP-3** and isolated after silica gel column chromatography (*n*-pentane : diethyl ether – 20:1 → 4:1) as a colorless solid (84%, 56.9 mg).

m.p.: 160 – 163 °C.

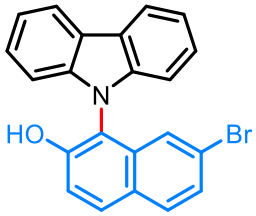
^{1}H NMR (400 MHz, $CDCl_3$): δ = 8.08 (d, *J* = 7.6 Hz, 2H), 7.77 (d, *J* = 8.9 Hz, 1H), 7.68 (d, *J* = 8.9 Hz, 1H), 7.26 (t, *J* = 7.0 Hz, 2H), 7.21 (t, *J* = 7.2 Hz, 2H), 7.16 (d, *J* = 8.9 Hz, 1H), 6.91 – 6.97 (m, 3H), 5.98 (d, *J* = 2.3 Hz, 1H), 5.15 (s, 1H), 3.24 (s, 3H) ppm.

^{13}C NMR (101 MHz, $CDCl_3$): δ = 159.2, 152.3, 140.9, 133.3, 130.7, 130.1, 126.5, 125.1, 123.9, 120.7, 120.6, 116.4, 115.2, 114.6, 110.5, 101.0, 55.1 ppm.

HRMS (ESI) *m/z*: $[M + Na]^+$ Calcd. for $C_{23}H_{17}NO_2Na^+$ 362.1152; Found 362.1160.

IR (KBr): 3858, 3479, 3055, 2936, 2834, 2673, 2324, 2252, 2086, 1992, 1895, 1622, 1515, 1459, 1390, 1354, 1336, 1312, 1264, 1225, 1185, 1144, 1066, 1029, 1005, 906, 832, 800, 728 cm^{-1}.

7-Bromo-1-(9*H*-carbazol-9-yl)naphthalen-2-ol (7t)



The title compound **7t** was synthesized according to the **GP-3** and isolated after silica gel column chromatography (*n*-pentane : diethyl ether – 20:1 → 4:1) as a colorless solid (75%, 58.2 mg).

m.p.: 155 – 162 °C.

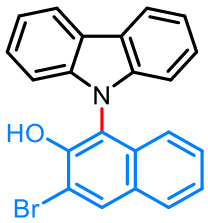
^{1}H NMR (600 MHz, $CDCl_3$): δ = 8.23 (d, *J* = 7.4 Hz, 2H), 7.95 (d, *J* = 9.0 Hz, 1H), 7.78 (d, *J* = 8.7 Hz, 1H), 7.46 – 7.43 (m, 2H), 7.40 – 7.35 (m, 4H), 7.03 (s, 1H), 6.96 (d, J = 7.9 Hz, 2H), 5.30 (s, 1H) ppm.

^{13}C NMR (151 MHz, $CDCl_3$): δ = 152.6, 140.8, 133.3, 131.0, 130.2, 128.2, 127.9, 126.8, 124.1, 124.0, 122.5, 121.0, 120.8, 118.4, 114.6, 110.2 ppm.

HRMS (APCI) *m/z*: $[M]^+$ Calcd. for $C_{22}H_{14}NOBr^+$ 387.0253; Found 387.0243.

IR (KBr): 3479, 3056, 2924, 2853, 2673, 2249, 2081, 1896, 1779, 1735, 1619, 1595, 1501, 1455, 1376, 1336, 1312, 1255, 1225, 1184, 1148, 1075, 994, 906, 868, 834, 726 cm^{-1}.

3-Bromo-1-(9*H*-carbazol-9-yl)naphthalen-2-ol (7u)



The title compound **7u** was synthesized according to the **GP-3** and isolated after silica gel column chromatography (*n*-pentane : diethyl ether – 20:1 → 4:1) as a colorless solid (61%, 47.5 mg).

m.p.: 218 – 222 °C.

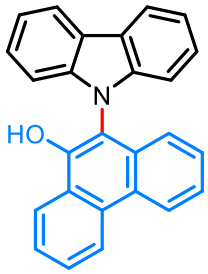
^{1}H NMR (600 MHz, $CDCl_3$): δ = 8.30 (s, 1H), 8.24 (d, *J* = 7.4 Hz, 2H), 7.85 (d, *J* = 8.2 Hz, 1H), 7.41 – 7.34 (m, 5H), 7.28 (d, *J* = 8.0 Hz, 1H), 6.96 (d, *J* = 7.6 Hz, 2H), 6.90 (d, *J* = 8.5 Hz, 1H), 5.73 (s, 1H) ppm.

^{13}C NMR (151 MHz, $CDCl_3$): δ = 148.6, 141.1, 133.1, 131.4, 129.8, 128.1, 127.6, 126.5, 125.4, 123.9, 122.5, 120.8, 120.7, 116.9, 111.8, 110.3 ppm.

HRMS (ESI) *m/z*: $[M + Na]^+$ Calcd. for $C_{22}H_{14}NONa^+$ 410.0151; Found 410.0167.

IR (KBr): 3855, 3467, 3057, 2924, 2854, 2674, 2315, 2112, 2000, 1908, 1707, 1618, 1584, 1503, 1451, 1396, 1339, 1311, 1227, 1186, 1134, 1071, 992, 852, 725 cm^{-1}.

10-(9*H*-Carbazol-9-yl)phenanthren-9-ol (7v)



The title compound **7v** was synthesized according to the **GP-3** and isolated after silica gel column chromatography (*n*-pentane : diethyl ether – 20:1 → 1:1) as a colorless solid (90%, 65.0 mg).

m.p.: 217 – 221 °C.

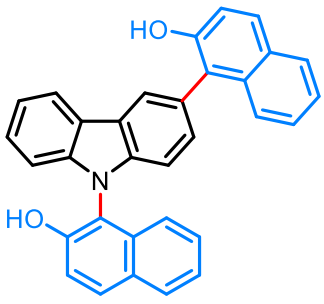
^{1}H NMR (600 MHz, $CDCl_3$): δ = 8.82 (d, *J* = 8.4 Hz, 1H), 8.74 (d, *J* = 8.3 Hz, 1H), 8.51 (dd, *J* = 8.1, 0.8 Hz, 1H), 8.29 – 8.27 (m, 2H), 7.85 (t, *J* = 7.7 Hz, 1H), 7.77 (t, *J* = 7.6 Hz, 1H), 7.52 (t, *J* = 7.6 Hz, 1H), 7.40 – 7.37 (m, 4H), 7.29 (t, *J* = 7.6 Hz, 1H), 7.08 – 7.06 (m, 2H), 6.77 (dd, *J* = 8.2, 0.7 Hz, 1H), 5.78 (s, 1H) ppm.

^{13}C NMR (151 MHz, $CDCl_3$): δ = 148.4, 141.2, 131.6, 130.0, 128.4, 127.7, 127.2, 127.0, 126.6, 125.0, 124.9, 123.9, 123.7, 123.0, 122.8, 122.5, 120.8, 120.7, 111.7, 110.5 ppm.

HRMS (ESI) *m/z*: $[M + Na]^+$ Calcd. for $C_{26}H_{17}NONa^+$ 382.1202; Found 382.1210.

IR (KBr): 3842, 3461, 3060, 2674, 2323, 2194, 2117, 2011, 1896, 1629, 1602, 1531, 1496, 1446, 1368, 1337, 1306, 1256, 1228, 1202, 1156, 1111, 1024, 850, 823, 749, 722, 685 cm^{-1}.

1,1'-(9*H*-Carbazole-3,9-diyl)bis(naphthalen-2-ol) (8)



Method A: In a 10.0 mL oven dried reaction tube, carbazole **1a** (0.3 mmol, 50.2 mg), 1-diazonaphthalen-2(1*H*)-one **5a** (0.66 mmol, 112.0 mg), [1,3-bis(2,6-diisopropylphenyl)imidazol-2-ylidene]AuCl (1 mol%, 1.9 mg), $Pd(OAc)_2$ (3 mol%, 2 mg) and $AgSbF_6$ (3 mol%, 3.1 mg) were taken and 3.0 mL of dry DCM was added. The reaction mixture was allowed to stir at 32 °C for 12 hours. After completion of the reaction, the crude product was purified by silica gel column chromatography using *n*-pentane/ diethyl ether as eluent (20:1 → 1:1) to obtained the product **8** as colorless solid (38%, 51.5 mg)

Method B: In a 10.0 mL oven dried reaction tube, carbazole 1a (0.2 mmol, 33.4 mg), diazoalkane (0.3 mmol, 51 mg), $Pd(OAc)_2$ (3 mol%, 1.4 mg) were taken and 2.0 mL of dry DCM was added. The reaction mixture was allowed to stir at 40 °C for 12 hours. After completion of the reaction, the crude product was purified by silica gel column chromatography using *n*-pentane/ diethyl ether eluent. After that, [1,3-

bis(2,6-diisopropylphenyl)imidazol-2-ylidene]AuCl (1 mol%, 1.3 mg) and $AgSbF_6$ (3 mol%, 2.1 mg) were to the reaction mixture. In another tube, diazoalkane **5a** (0.2 mmol, 34 mg) was dissolved in 1 mL dry DCM and added to the reaction mixture over 1 hour via syringe pump and stirred for 6 hours. Then, the crude product was purified by silica gel column chromatography using *n*-pentane/ diethyl ether as eluent (20:1 → 1:1) to obtain the product **8** as colorless solid (51%, 46 mg).

m.p.: 156 – 162 °C.

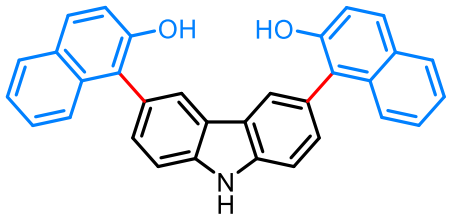
^{1}H NMR (600 MHz, $CDCl_3$): δ = 8.29 (s, 1H), 8.19 (d, *J* = 7.6 Hz, 1H), 8.04 (d, *J* = 9.0 Hz, 1H), 7.96 (dd, *J* = 8.1, 3.3 Hz, 1H), 7.85 (d, *J* = 8.8 Hz, 2H), 7.55 – 7.53 (m, 0.5H), 7.50 – 7.48 (m, 1.5H), 7.44 – 7.40 (m, 3H), 7.37 – 7.30 (m, 5H), 7.19 (d, *J* = 8.2 Hz, 1H), 7.05 (d, *J* = 8.1 Hz, 1H), 7.00 (d, *J* = 8.4 Hz, 0.48H), 6.94 (d, *J* = 8.5 Hz, 0.52H), 5.41 (s, 0.52H), 5.38 (s, 0.52H), 5.36 (s, 0.48H), 5.32 (s, 0.48H) ppm.

^{13}C NMR (151 MHz, $CDCl_3$): δ = 151.8, 151.7, 150.8, 141.7, 141.14, 141.12, 134.1, 134.0, 131.9, 131.8, 131.38, 131.36, 129.9, 129.6, 129.5, 129.4, 129.1, 128.7, 128.2, 127.9, 127.3, 127.2, 126.6, 126.0, 125.1, 125.0, 124.9, 124.5, 123.5, 123.4, 123.44, 123.41, 122.0, 121.9, 121.6, 121.5, 121.21, 121.20, 120.9, 118.0, 117.46, 117.45, 115.1, 115.0, 111.6, 110.7 ppm.

HRMS (ESI) *m/z*: $[M + Na]^+$ Calcd. for $C_{32}H_{21}NO_2Na^+$ 474.1465; Found 474.1461.

IR (KBr): 3880, 3649, 3504, 3053, 2924, 2853, 2663, 2324, 2170, 2100, 1982, 1897, 1759, 1621, 1597, 1512, 1480, 1457, 1388, 1326, 1265, 1228, 1200, 1170, 1140, 1070, 1024, 970, 893. 862, 813, 774, 742 cm^{-1}.

1,1'-(9*H*-Carbazole-3,6-diyl)bis(naphthalen-2-ol) (9)



In a 10.0 mL oven dried reaction tube, carbazole **1a** (0.2 mmol, 33.4 mg), [1,3-bis(2,6-diisopropylphenyl)imidazol-2-ylidene]AuCl (3 mol%, 3.7 mg) and $AgSbF_6$ (9 mol%, 6.2 mg) were taken and 1.5 mL of dry DCM was added. In another tube, diazoalkane (0.42 mmol, 71.5 mg) was dissolved in 1 mL dry DCM and added to the reaction mixture over 1 hour via syringe pump. The reaction mixture was allowed to stir for 12 hours. After completion of the reaction, the crude product was purified by silica gel column chromatography using *n*-pentane/ diethyl ether (20:1 → 1:1) eluent to afford compound **9** as colorless solid in 46% yield (41.4 mg).

m.p.: 168 – 172 °C.

^{1}H NMR (600 MHz, $CDCl_3$): δ = 8.42 (br, 1H), 8.11 (s, 2H), 7.83 (d, *J* = 8.6 Hz, 4H), 7.71 (d, *J* = 8.3 Hz, 2H), 7.50 (d, *J* = 8.3 Hz, 2H), 7.46 – 7.45 (m, 2H), 7.32 – 7.29 (m, 6H), 5.27 (s, 2H) ppm.

^{13}C NMR (151 MHz, $CDCl_3$): δ = 150.8, 139.9, 134.0, 129.60, 129.55, 129.52, 129.1, 128.2, 126.6, 126.5, 125.3, 125.0, 124.2, 123.4, 123.3, 123.37, 121.5, 117.43, 117.41, 112.3 ppm.

HRMS (ESI) *m/z*: $[M + K]^+$ Calcd. for $C_{32}H_{21}NO_2K^+$ 490.1204; Found 490.1221.

IR (KBr): 3865, 3645, 3515, 3413, 3056, 2924, 2854, 2651, 2288, 2076, 2009, 1895, 1720, 1617, 1597, 1511, 1490, 1464, 1387, 1345, 1309, 1281, 1239, 1194, 1170, 1141, 1026, 983, 949, 894, 864, 813, 747, 675 cm^{-1}.

References:

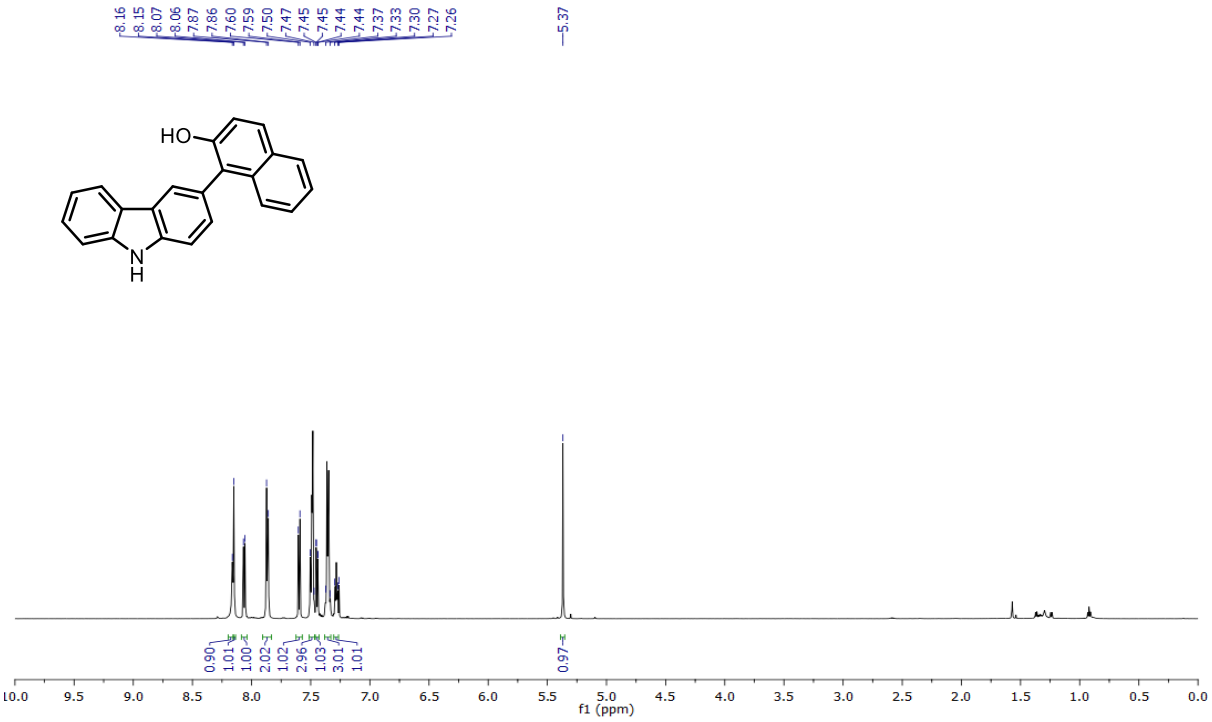
1. D. Dar'in, G. Kantin and M. A Krasavin, *Chem. Commun*., 2019, **55**, 5239–5242.

2. (*a*) M. Kitamura, R. Sakata, N. Tashiro, A. Ikegami and T. Okauchi, *Bull. Chem. Soc. Jpn*., 2015, **88**, 824–833; (*b*) A. C. S. Reddy, P. M. Reddy, P. Anbarasan, *Adv. Synth. Catal*., 2020, **362**, 801–806; (*c*) Z. Liu, J.-Q. Wu and S. D. Yang, *Org. Lett*., 2017, **19**, 5434−5437.

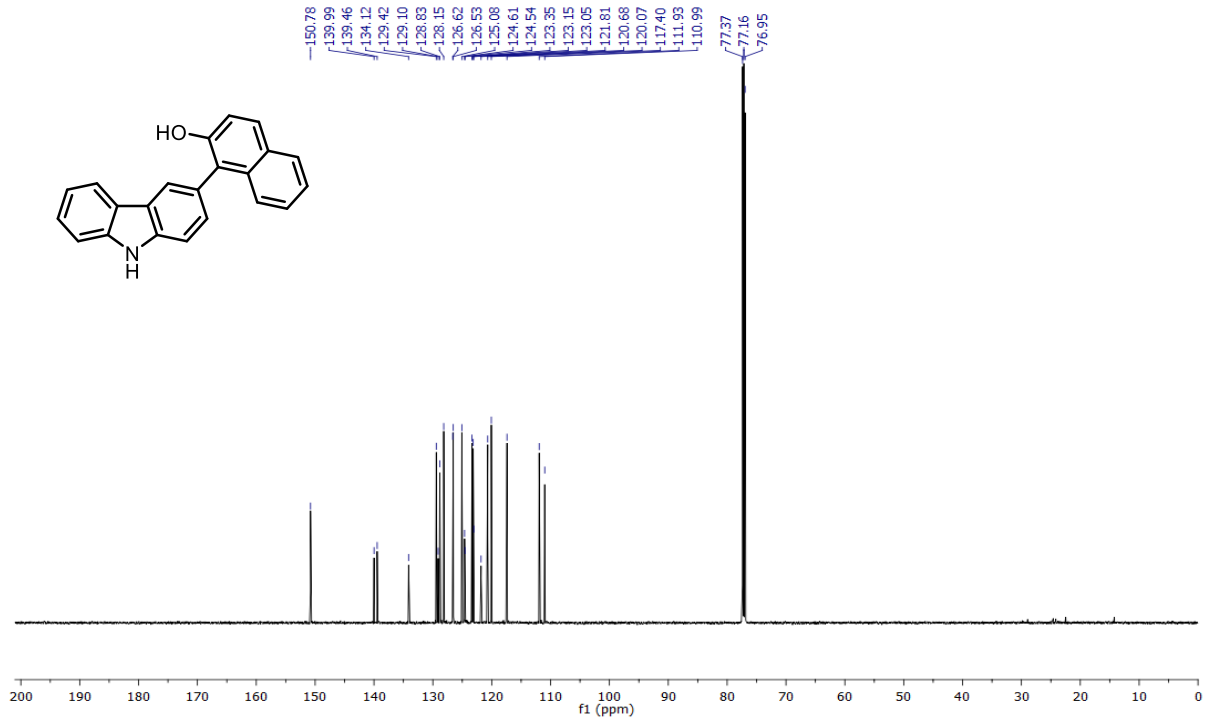
Spectra of compounds

1-(9*H*-Carbazol-3-yl)naphthalen-2-ol (6a)

^{1}H NMR (600 MHz, Chloroform-*d*)

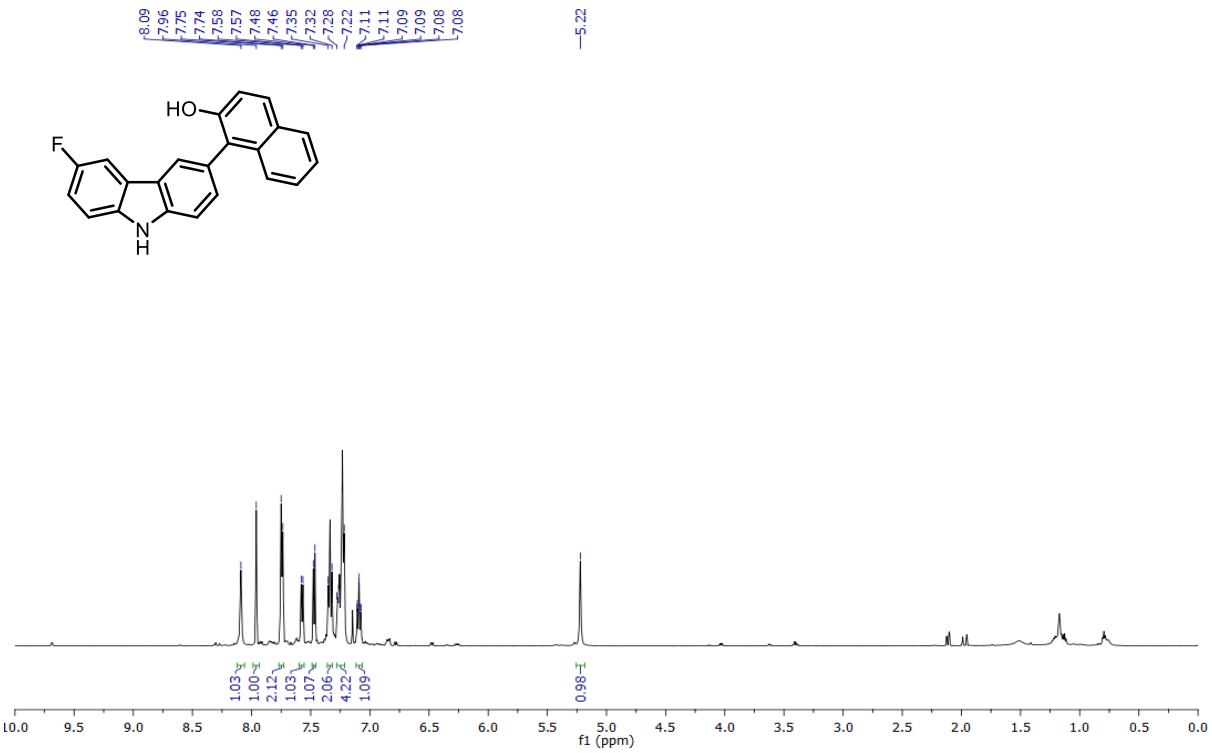


^{13}C NMR (151 MHz, Chloroform-*d*)

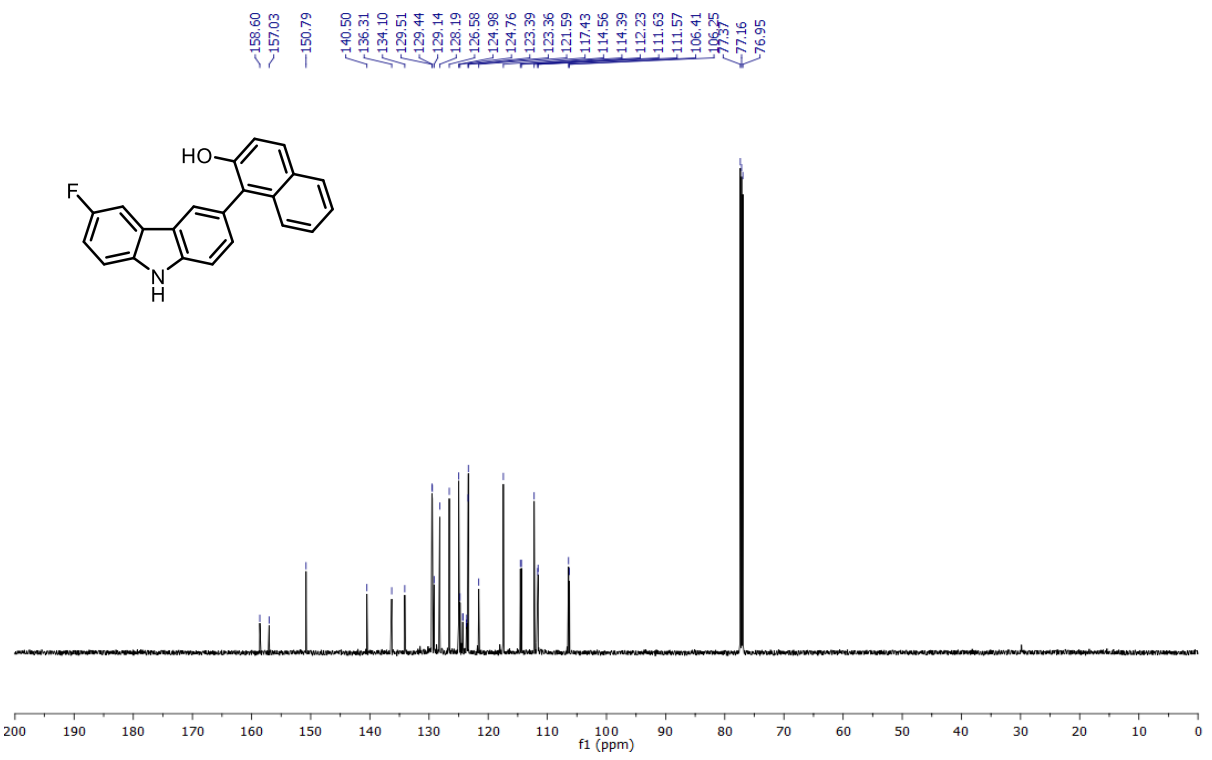


1-(6-Fluoro-9*H*-carbazol-3-yl)naphthalen-2-ol (6b)

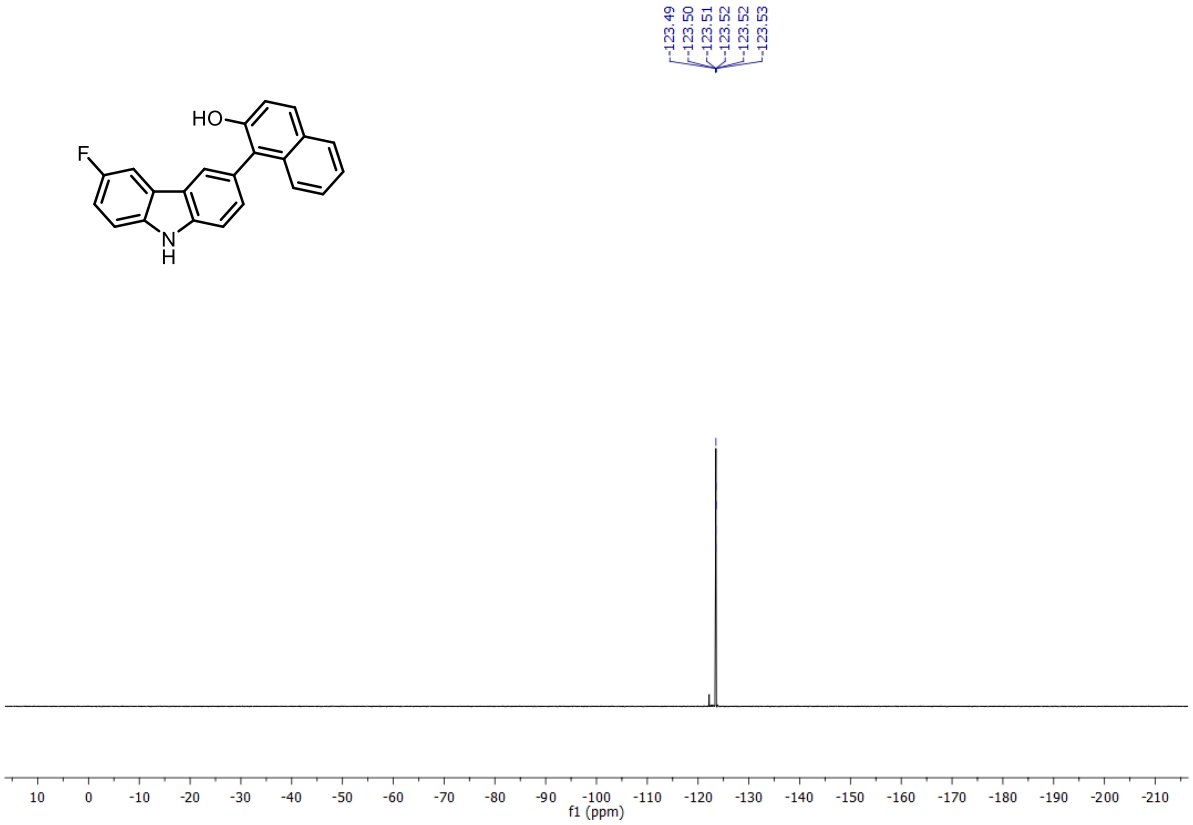
^{1}H NMR (600 MHz, Chloroform-*d*)



^{13}C NMR (151 MHz, Chloroform-*d*)

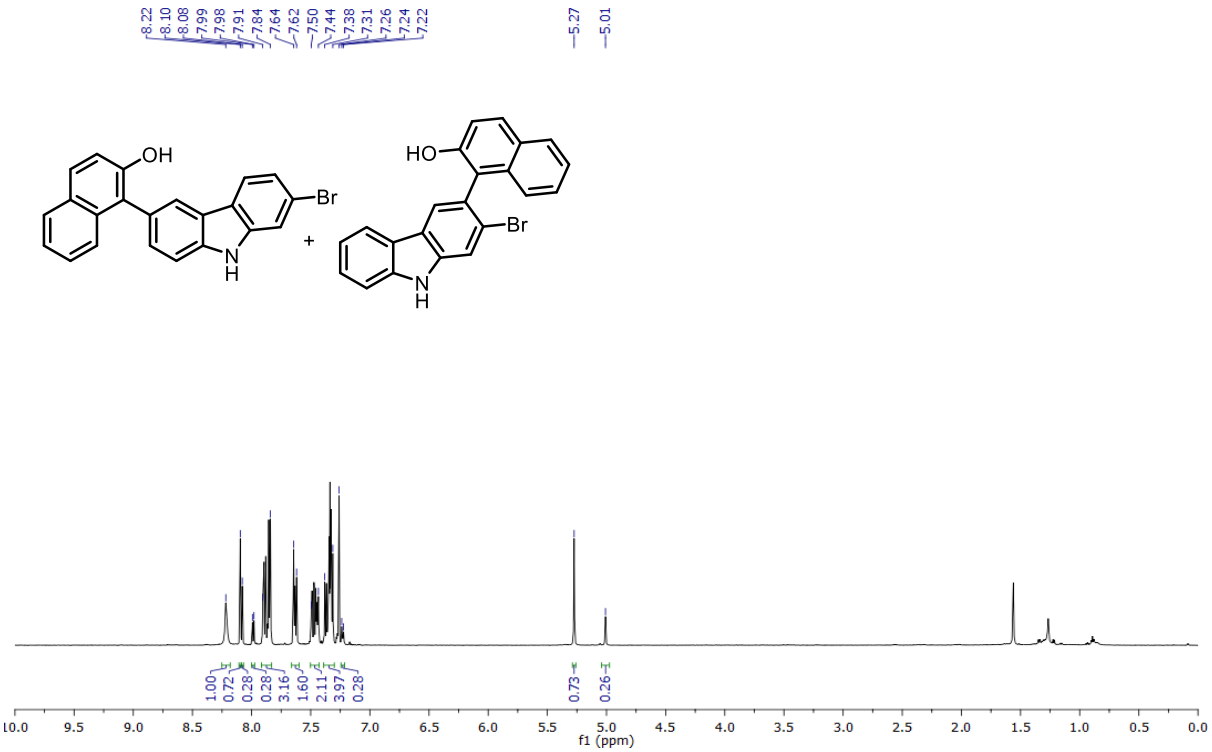


^{19}F NMR (565 MHz, Chloroform-*d*)

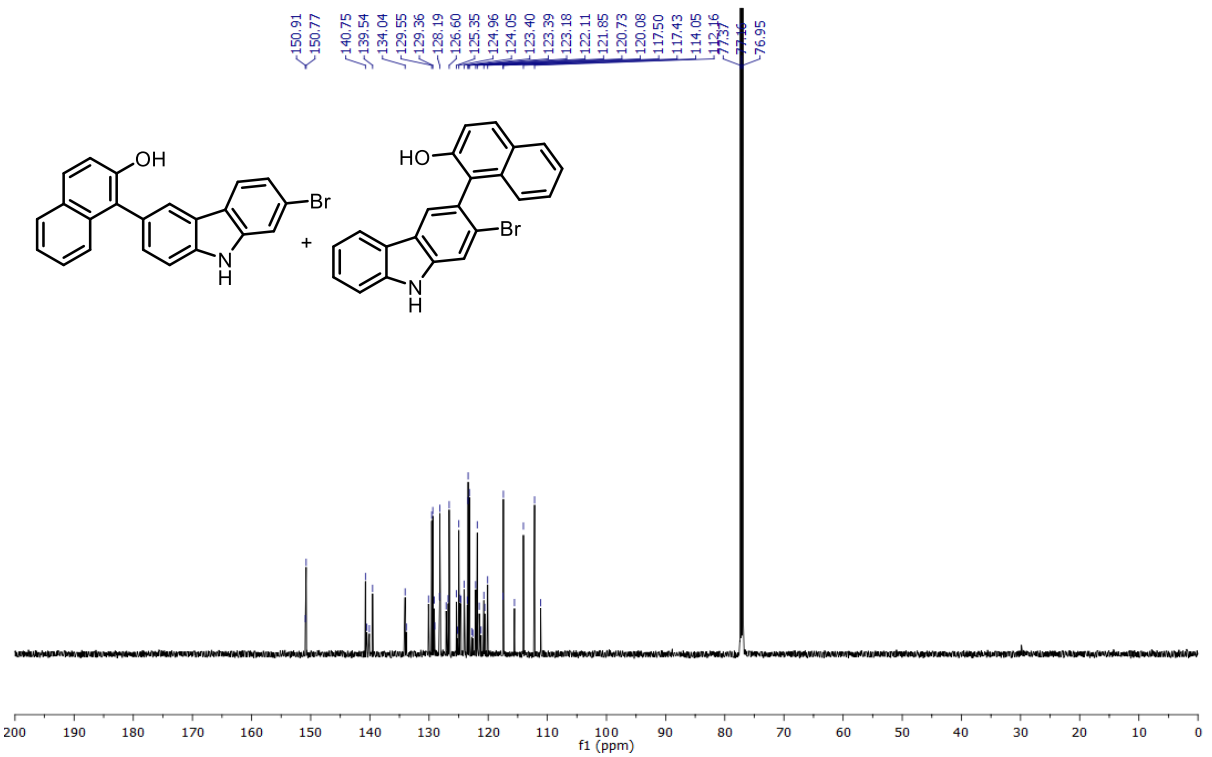


1-(7-Bromo-9*H*-carbazol-3-yl)naphthalen-2-ol (6c) and 1-(2-Bromo-9*H*-carbazol-3-yl)naphthalen-2-ol (6c')

^{1}H NMR (600 MHz, Chloroform-*d*)

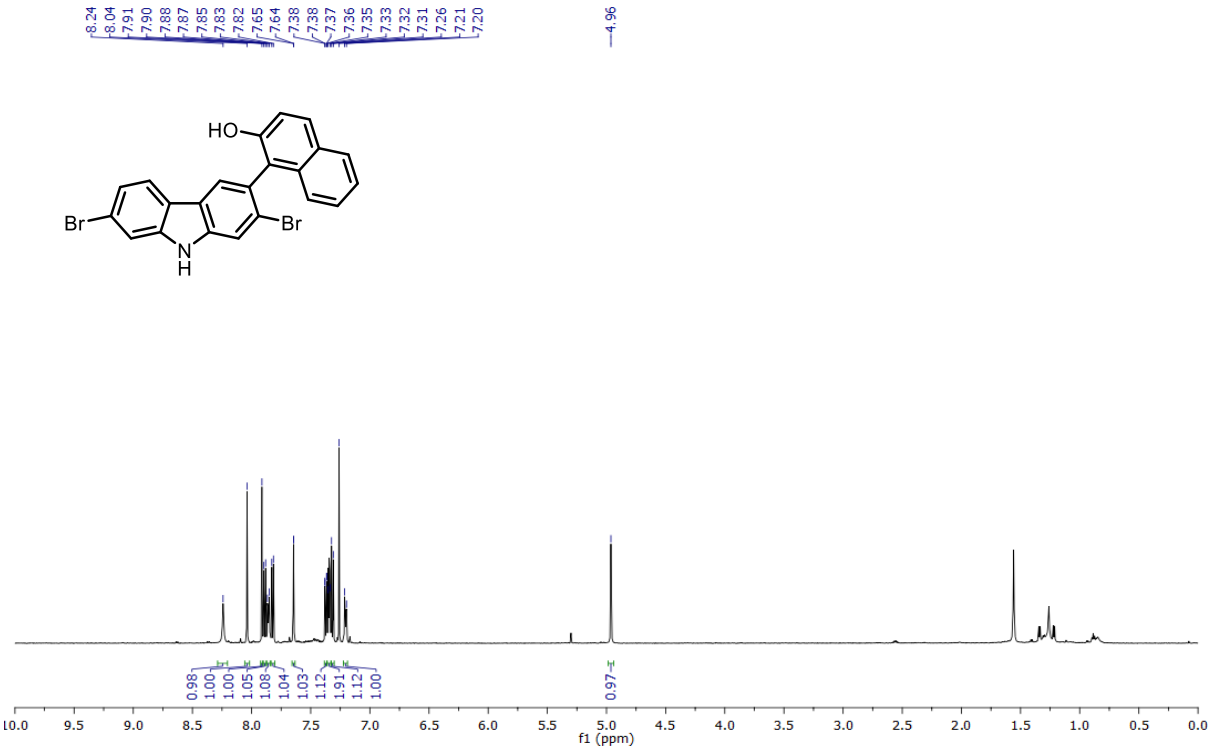


^{13}C NMR (151 MHz, Chloroform-*d*)

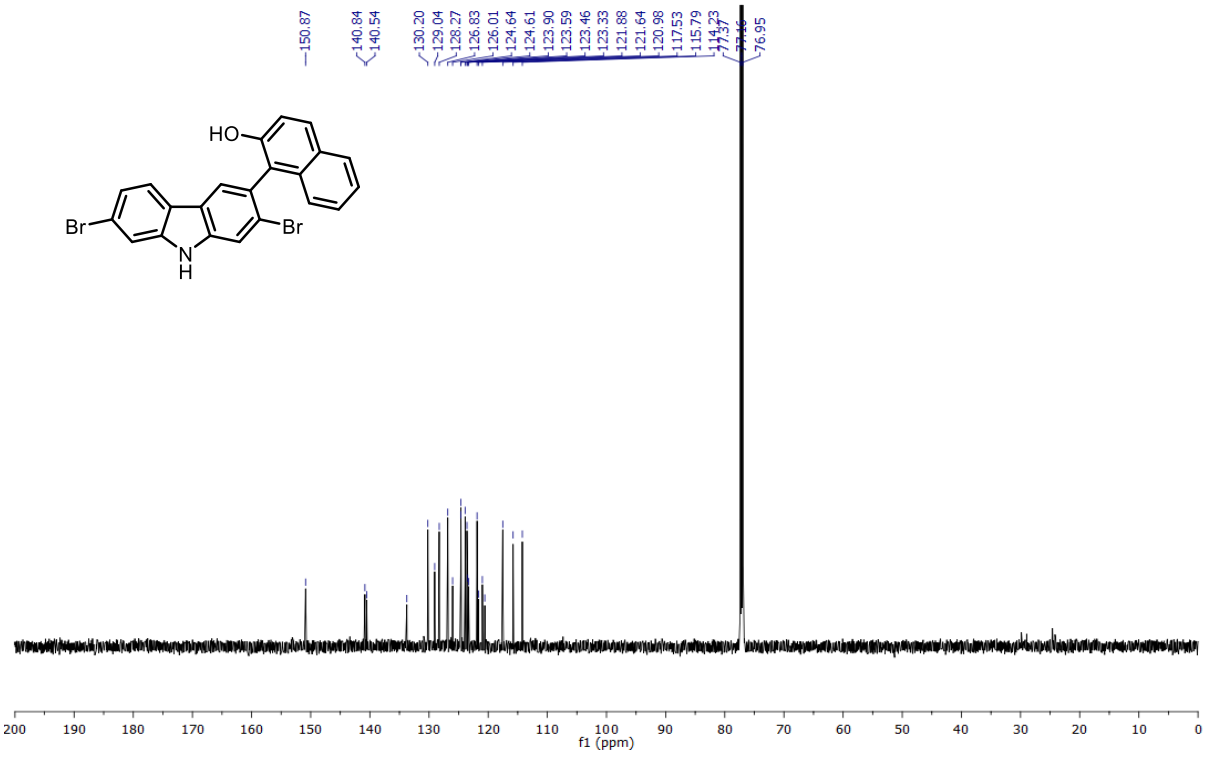


1-(2,7-Dibromo-9*H*-carbazol-3-yl)naphthalen-2-ol (6d)

^{1}H NMR (600 MHz, Chloroform-*d*)

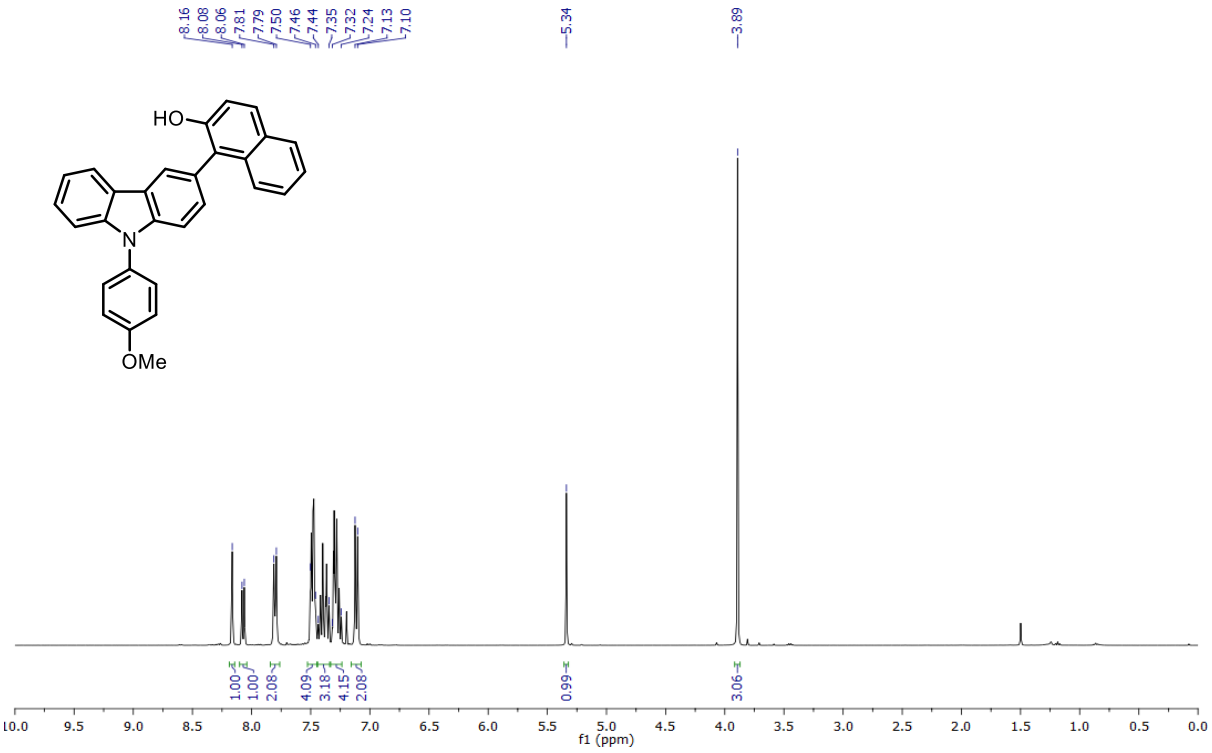


^{13}C NMR (151 MHz, Chloroform-*d*)

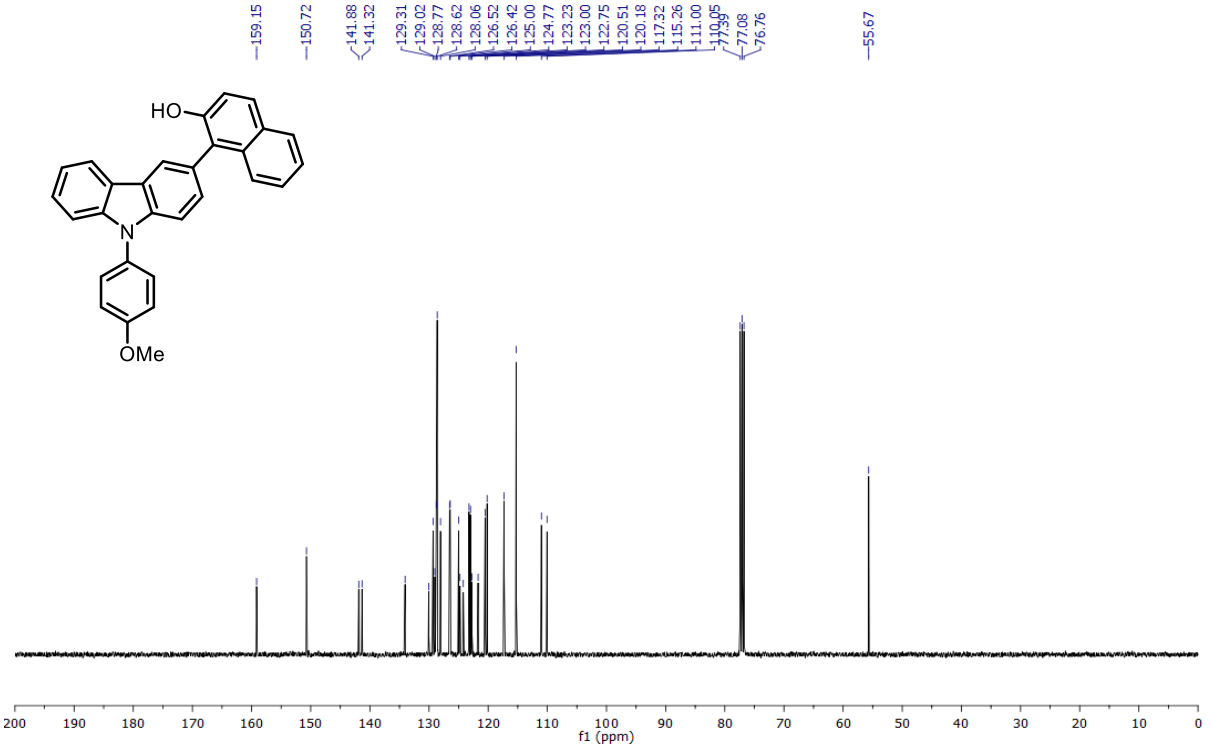


1-(9-(4-Methoxyphenyl)-9*H*-carbazol-3-yl)naphthalen-2-ol (6e)

^{1}H NMR (400 MHz, Chloroform-*d*)

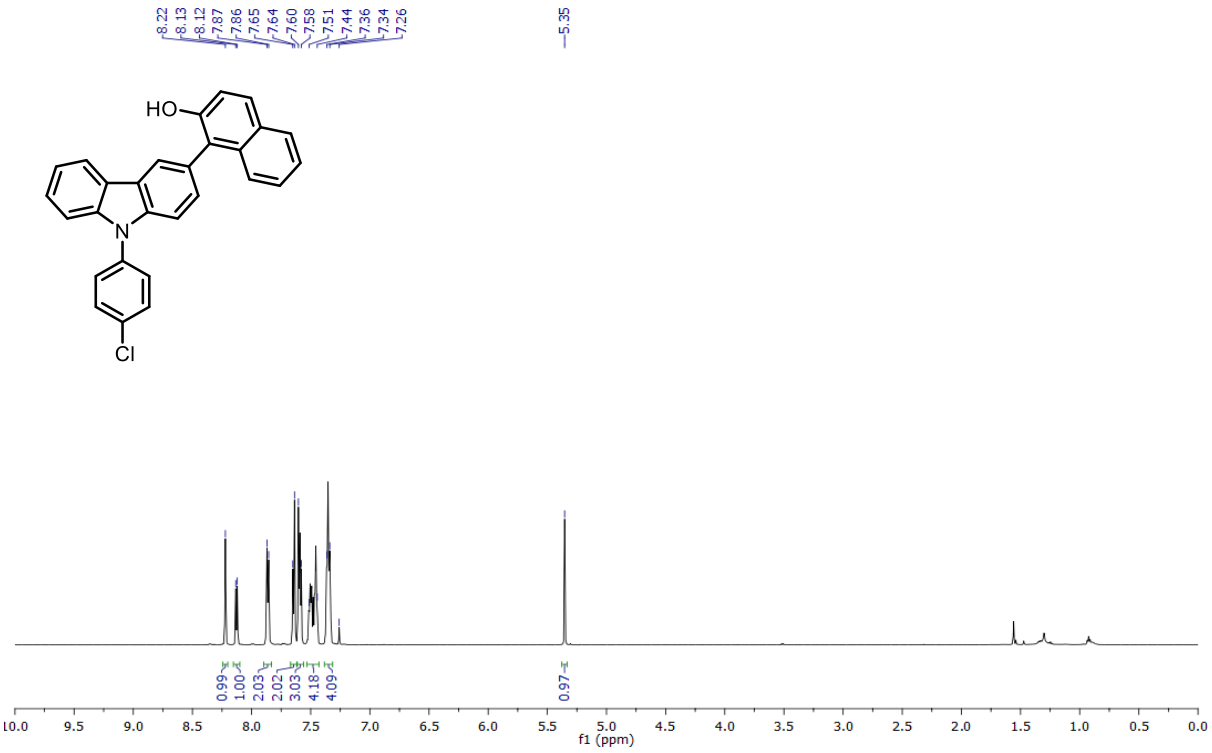


^{13}C NMR (101 MHz, Chloroform-*d*)

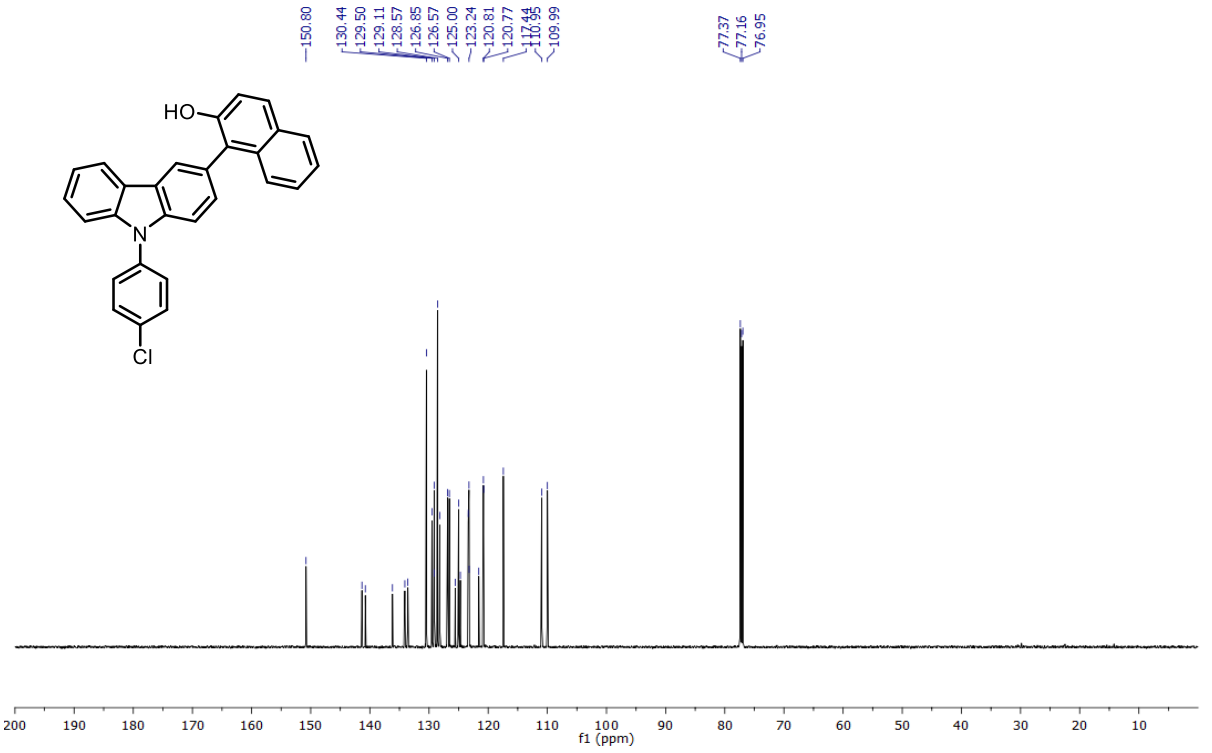


1-(9-(4-Chlorophenyl)-9*H*-carbazol-3-yl)naphthalen-2-ol (6f)

^{1}H NMR (600 MHz, Chloroform-*d*)

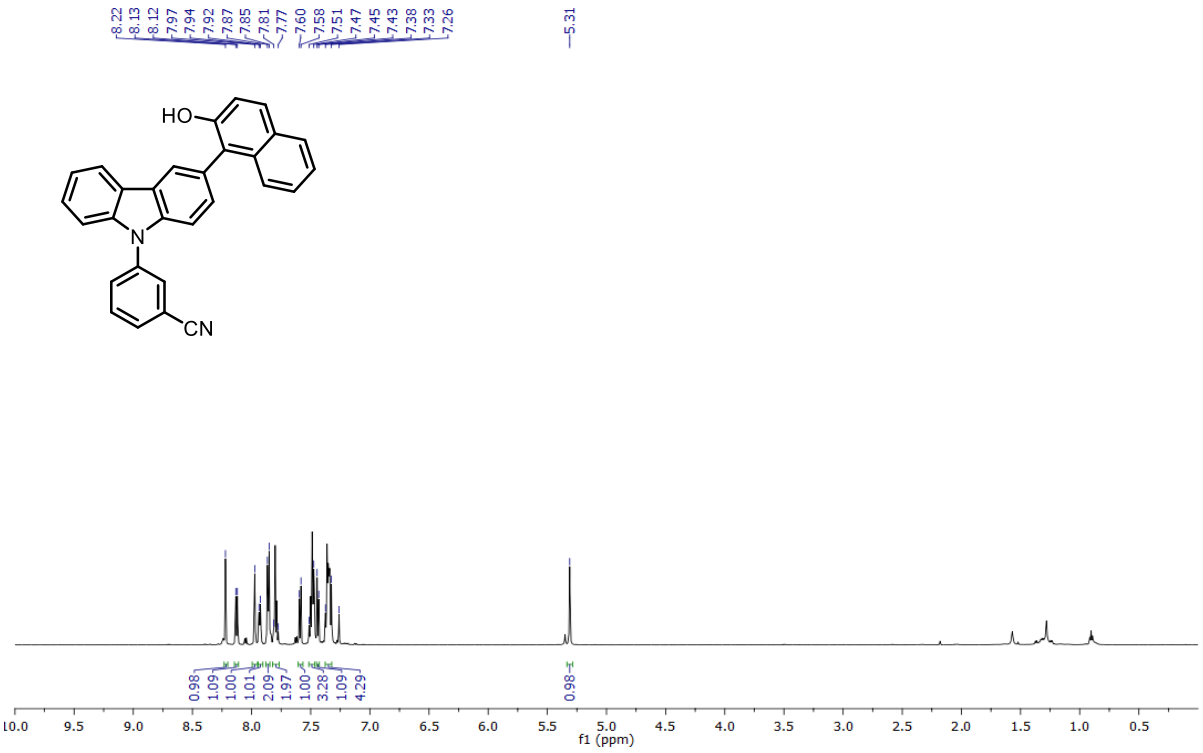


^{13}C NMR (151 MHz, Chloroform-*d*)

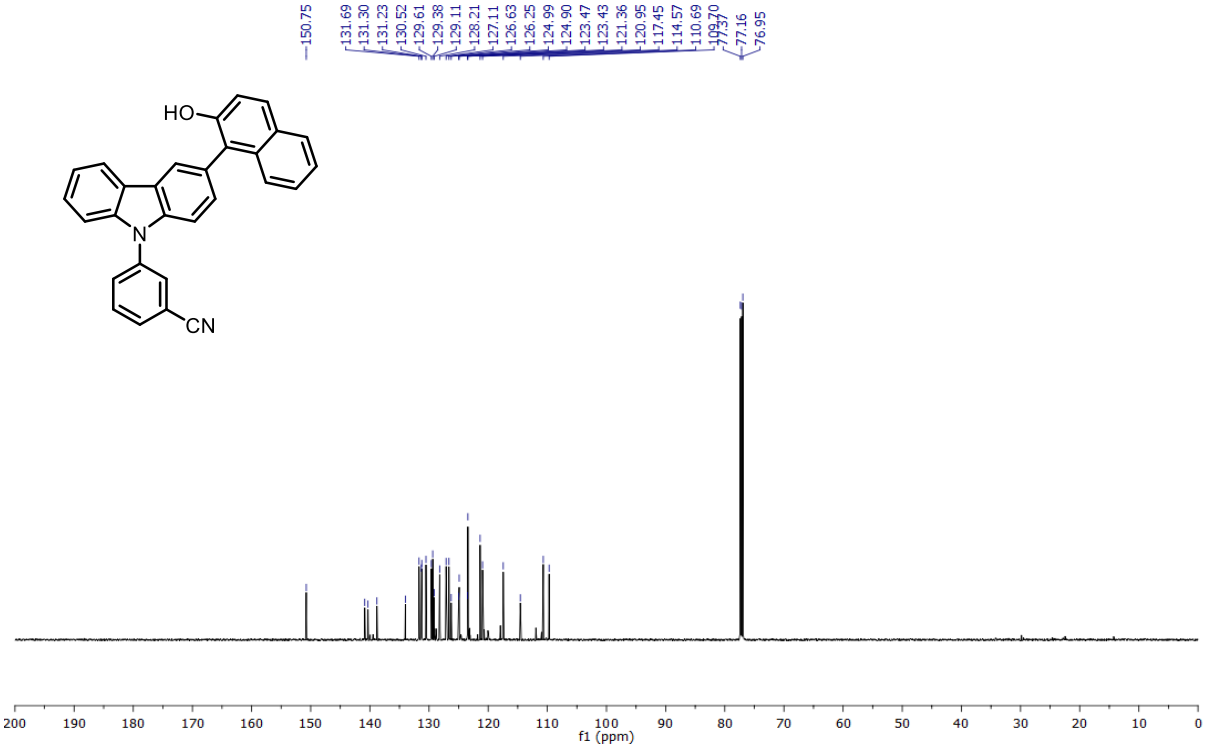


3-(3-(2-Hydroxynaphthalen-1-yl)-9*H*-carbazol-9-yl)benzonitrile (6g)

^{1}H NMR (600 MHz, Chloroform-*d*)

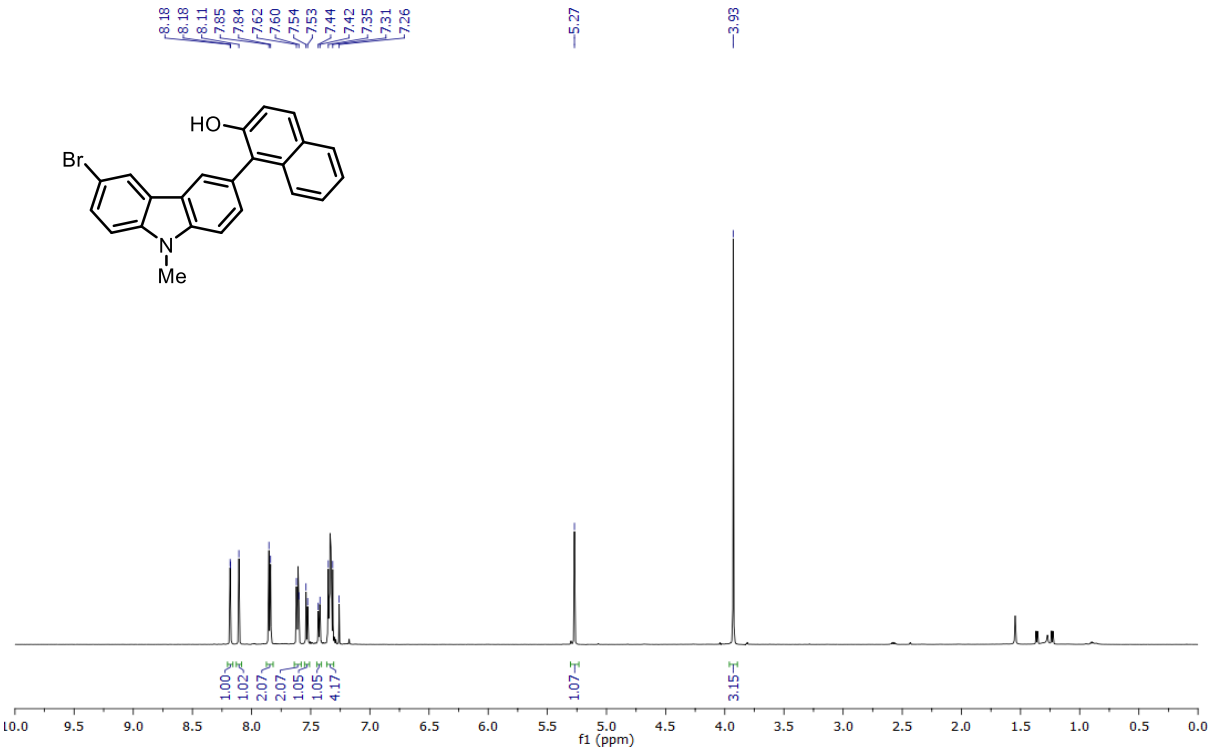


^{13}C NMR (151 MHz, Chloroform-*d*)

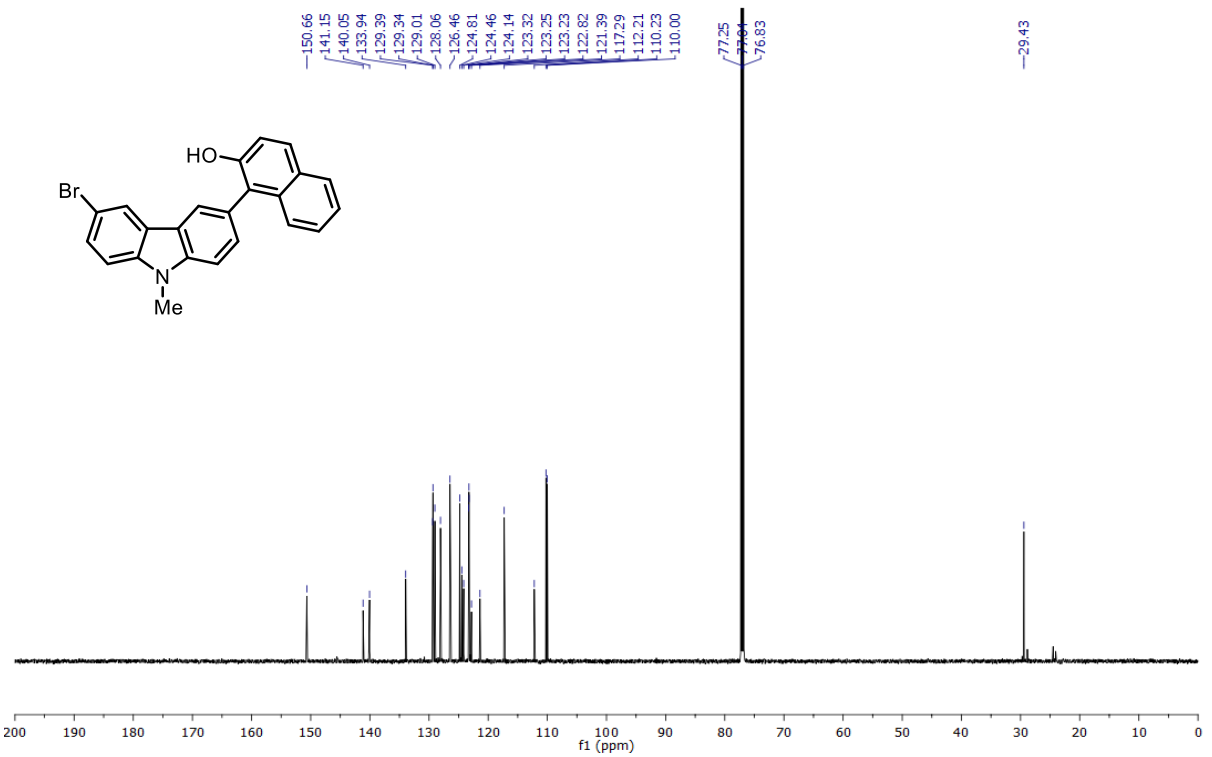


1-(6-Bromo-9-methyl-9*H*-carbazol-3-yl)naphthalen-2-ol (6h)

^{1}H NMR (600 MHz, Chloroform-*d*)

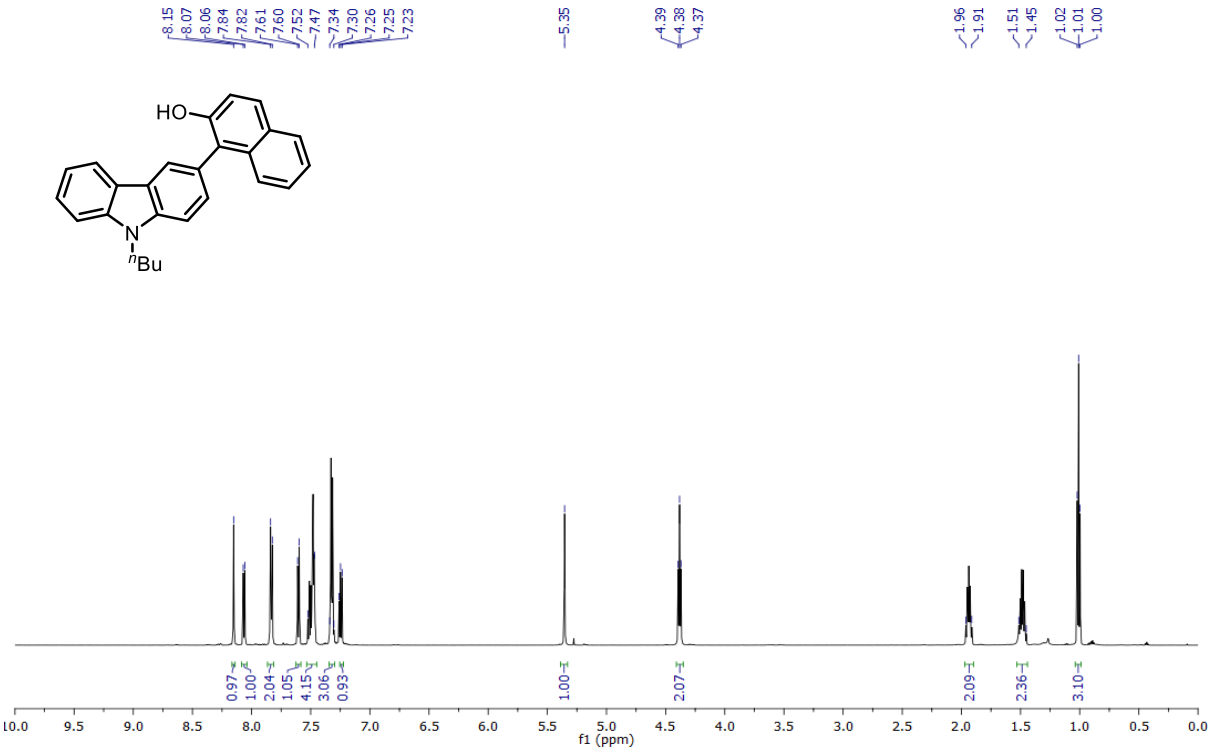


^{13}C NMR (151 MHz, Chloroform-*d*)

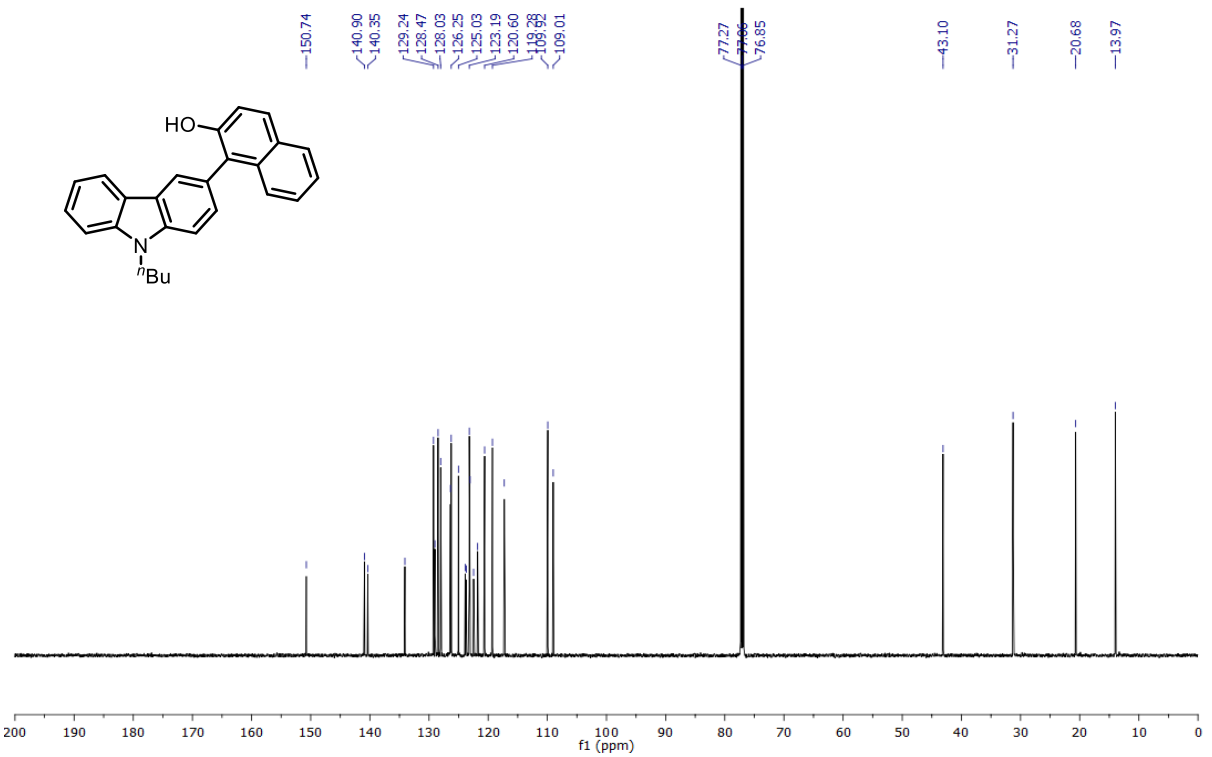


1-(9-Butyl-9*H*-carbazol-3-yl)naphthalen-2-ol (6i)

^{1}H NMR (600 MHz, Chloroform-*d*)

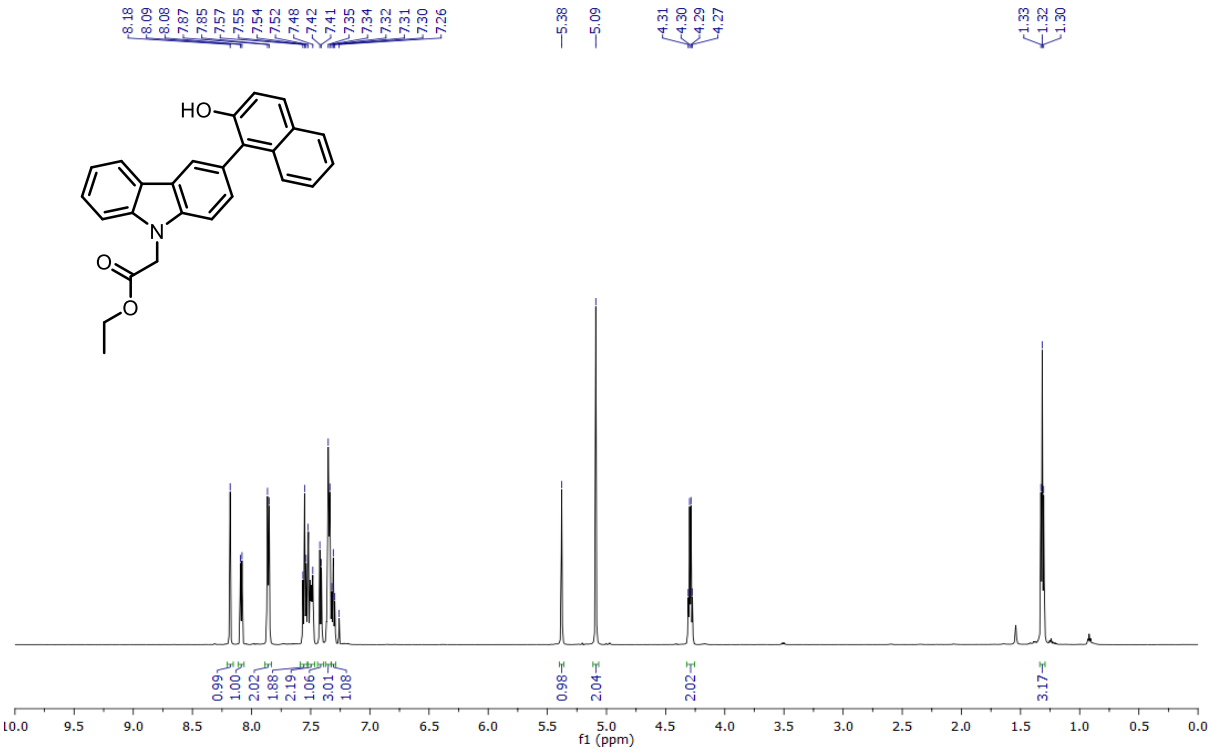


^{13}C NMR (151 MHz, Chloroform-*d*)

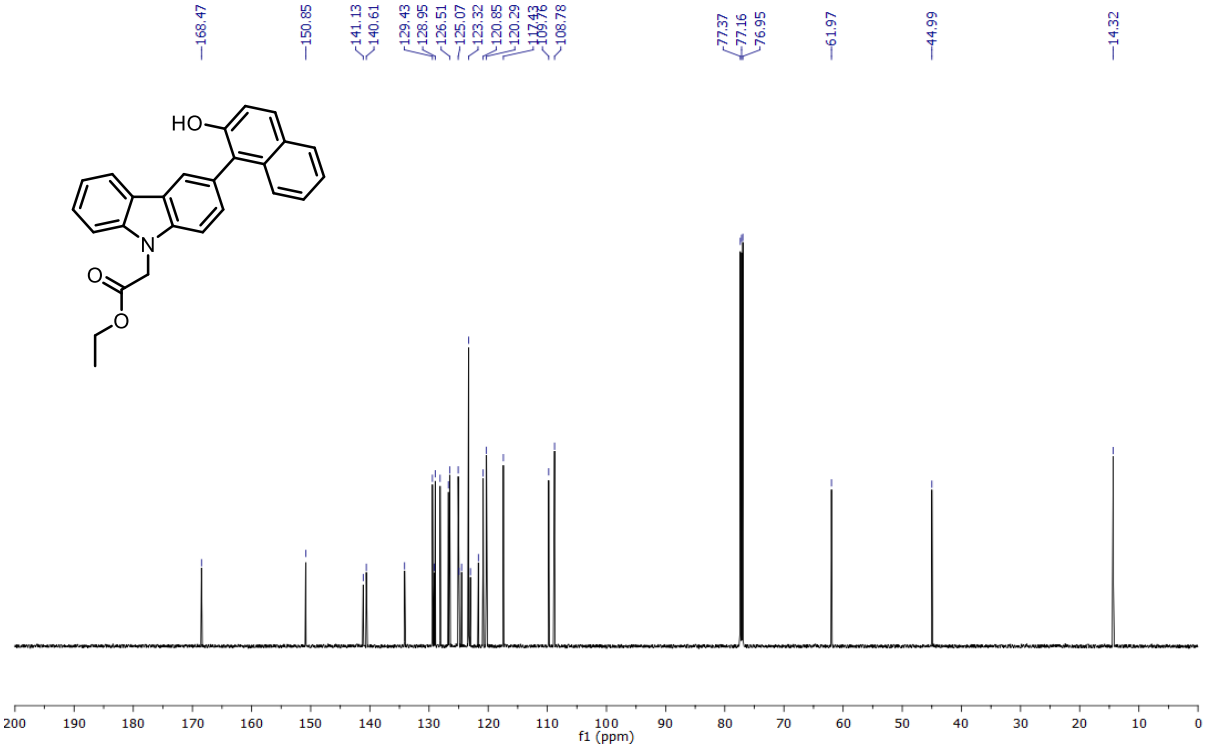


Ethyl 2-(3-(2-hydroxynaphthalen-1-yl)-9*H*-carbazol-9-yl)acetate (6j)

^{1}H NMR (600 MHz, Chloroform-*d*)

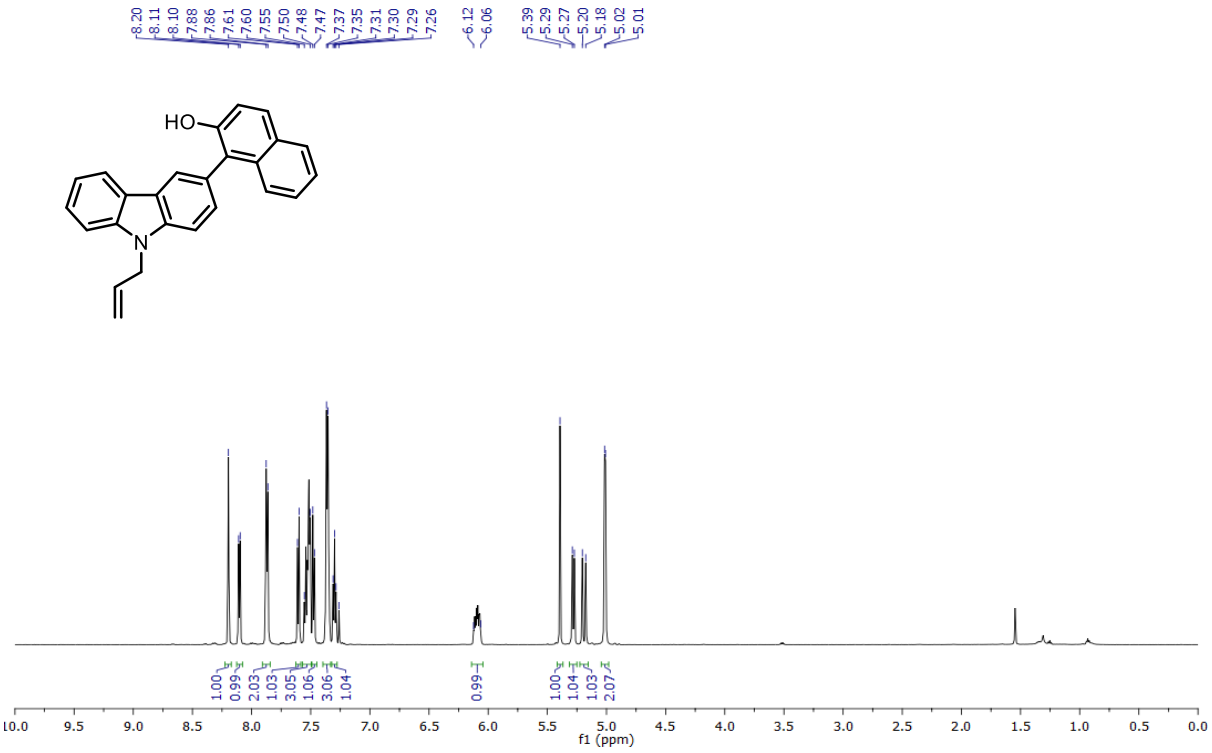


^{13}C NMR (151 MHz, Chloroform-*d*)

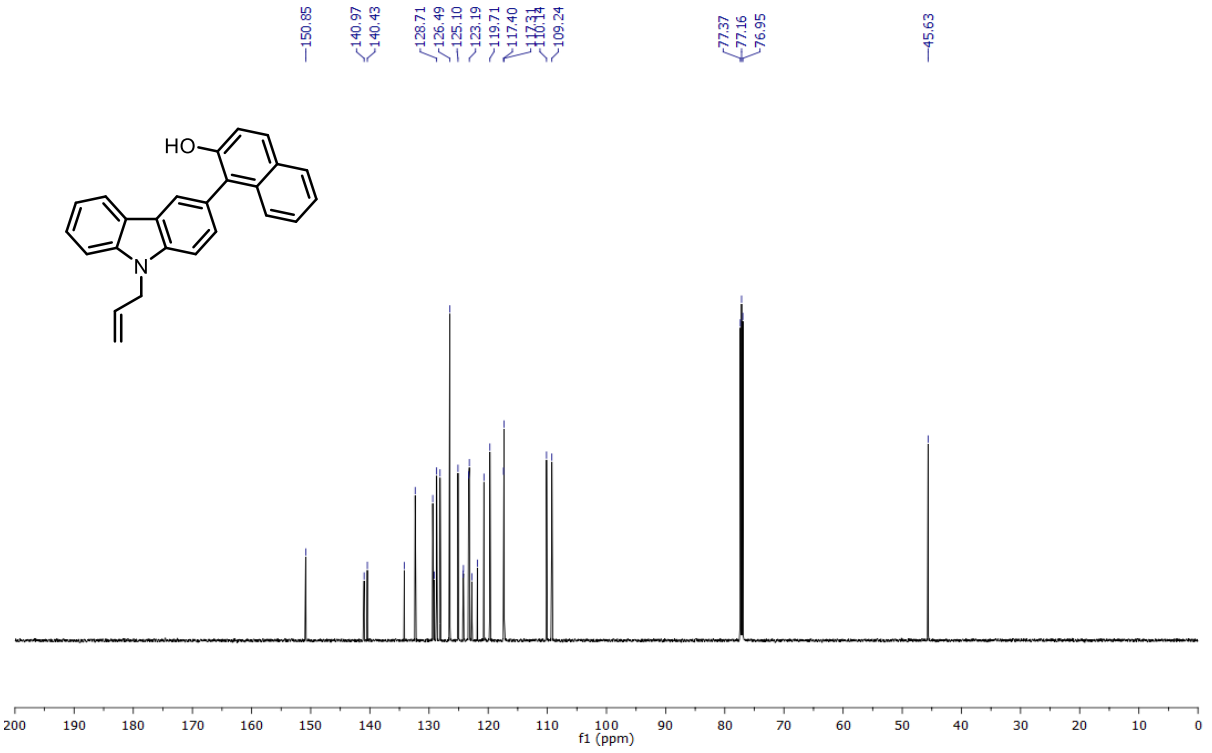


1-(9-Allyl-9*H*-carbazol-3-yl)naphthalen-2-ol (6k)

^{1}H NMR (600 MHz, Chloroform-*d*)

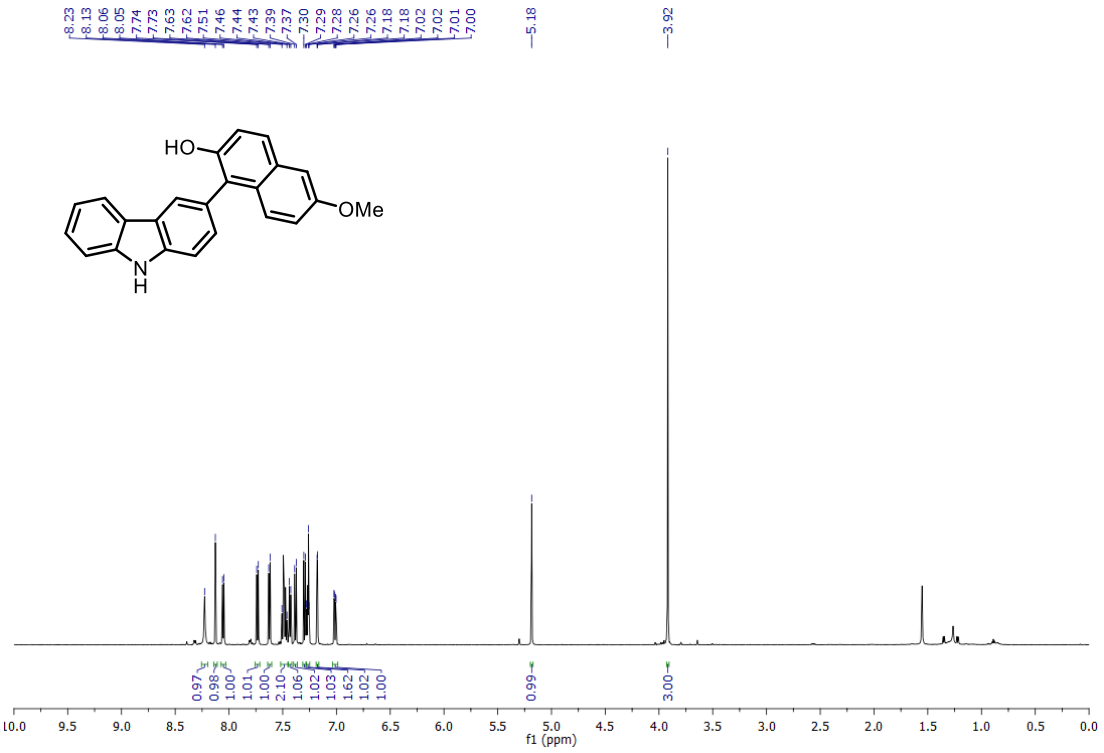


^{13}C NMR (151 MHz, Chloroform-*d*)

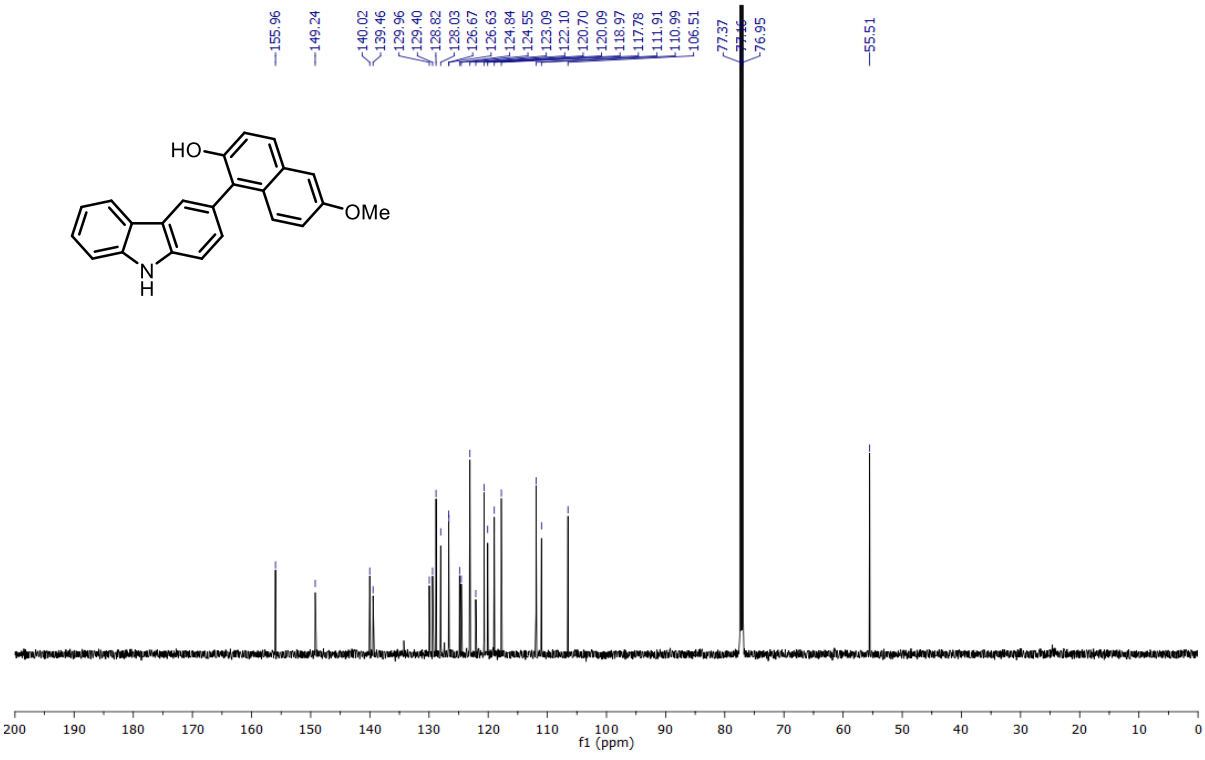


1-(9*H*-Carbazol-3-yl)-6-methoxynaphthalen-2-ol (6l)

^{1}H NMR (600 MHz, Chloroform-*d*)

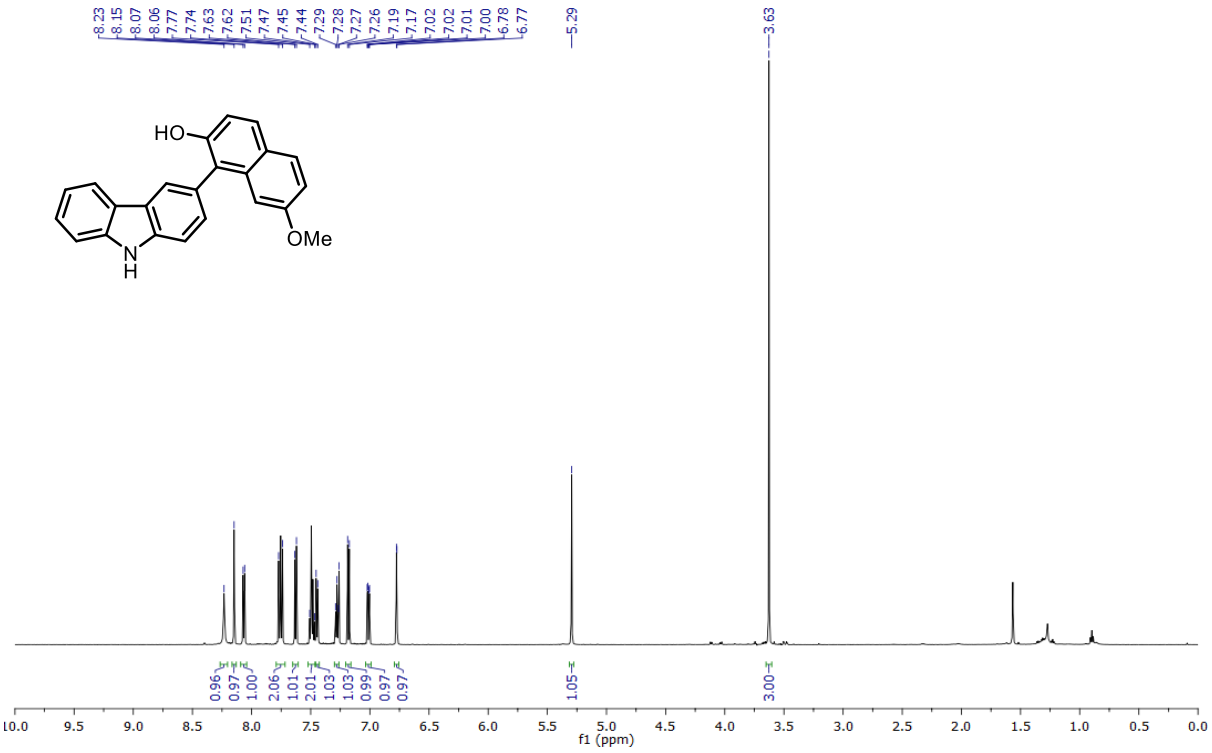


^{13}C NMR (151 MHz, Chloroform-*d*)

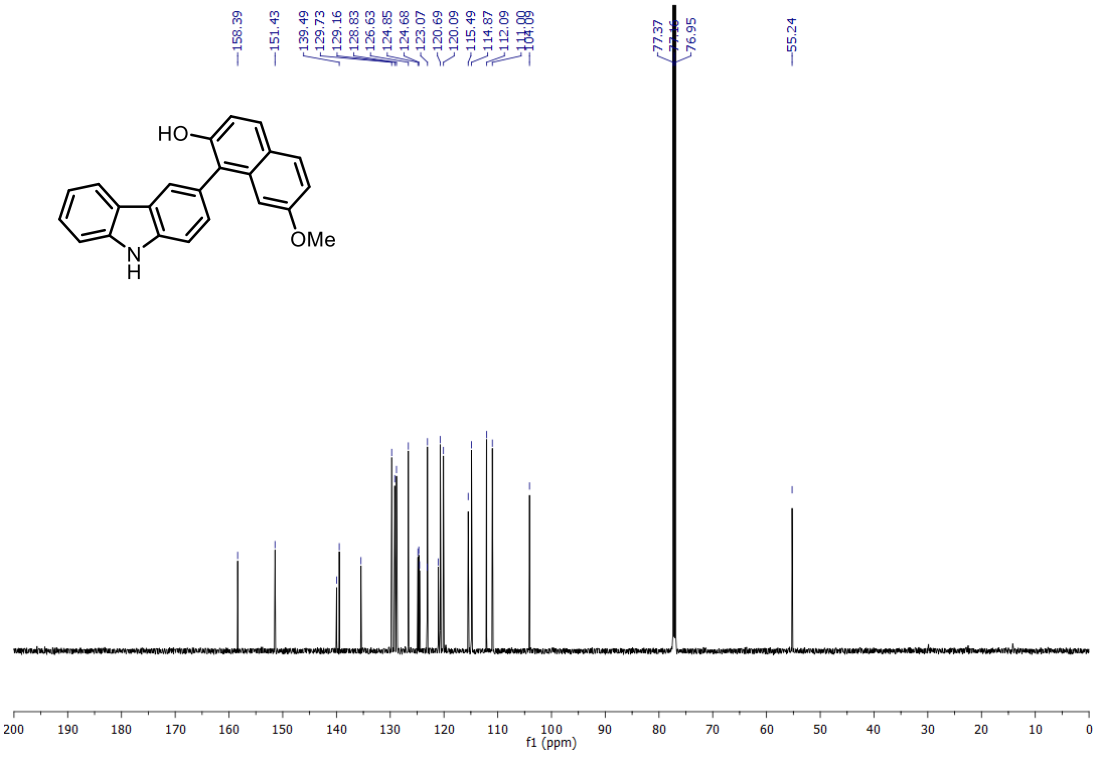


1-(9*H*-Carbazol-3-yl)-7-methoxynaphthalen-2-ol (6m)

^{1}H NMR (600 MHz, Chloroform-*d*)

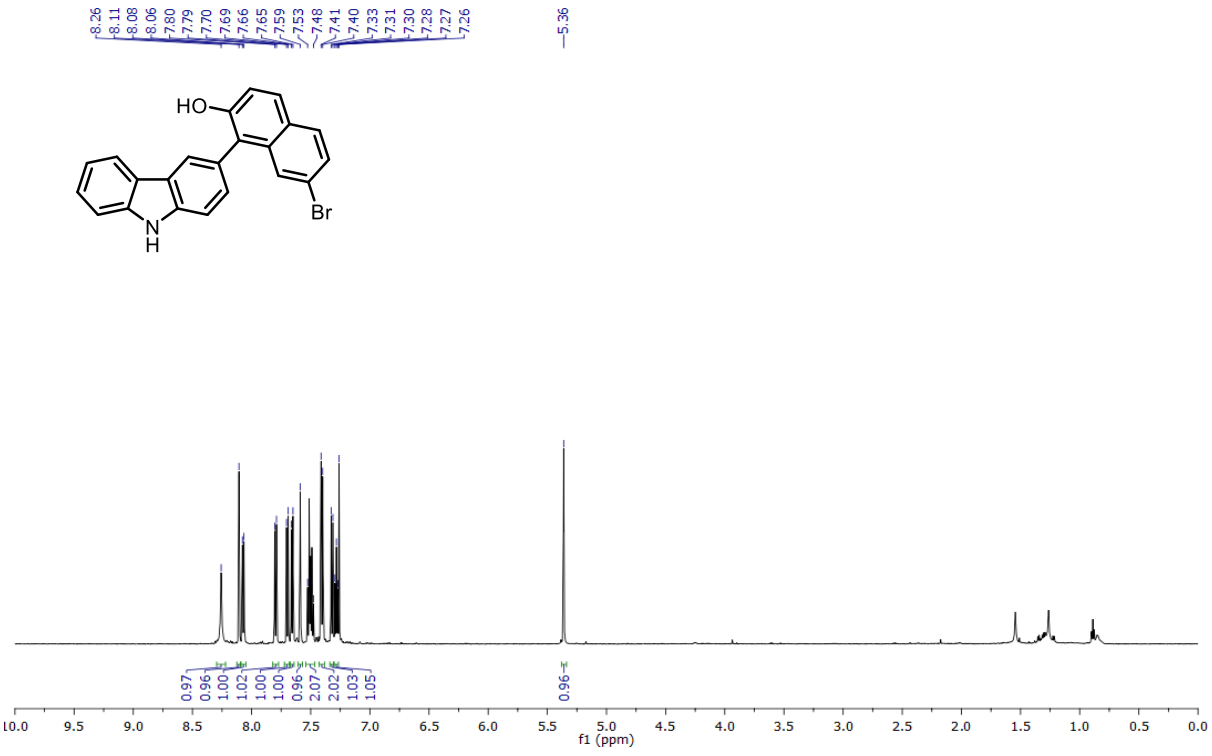


^{13}C NMR (151 MHz, Chloroform-*d*)

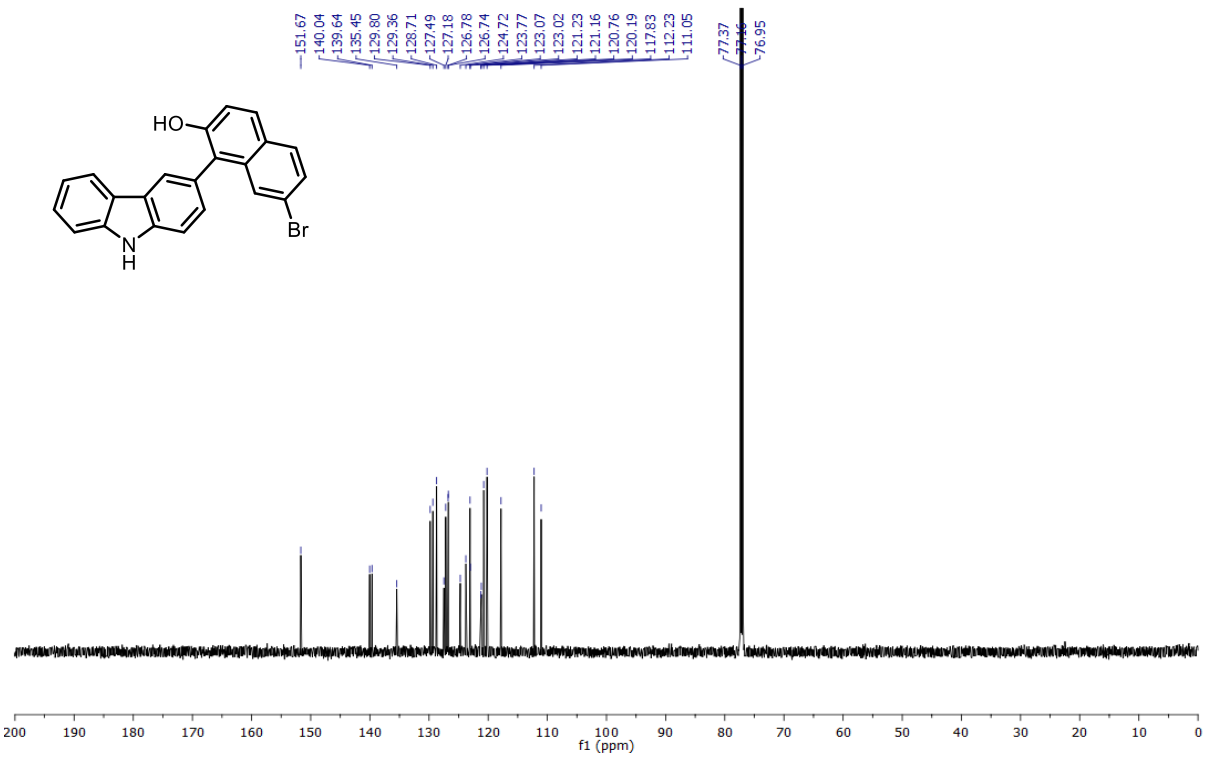


7-Bromo-1-(9*H*-carbazol-3-yl)naphthalen-2-ol (6n)

^{1}H NMR (600 MHz, Chloroform-*d*)

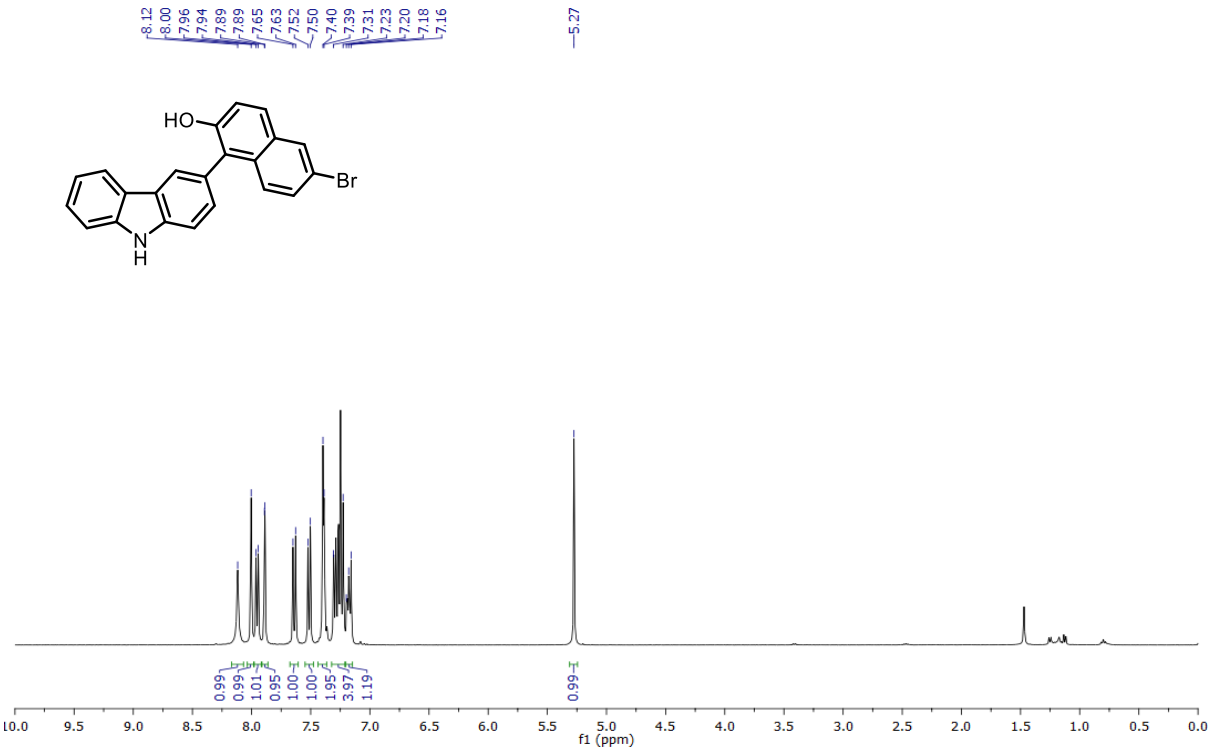


^{13}C NMR (151 MHz, Chloroform-*d*)

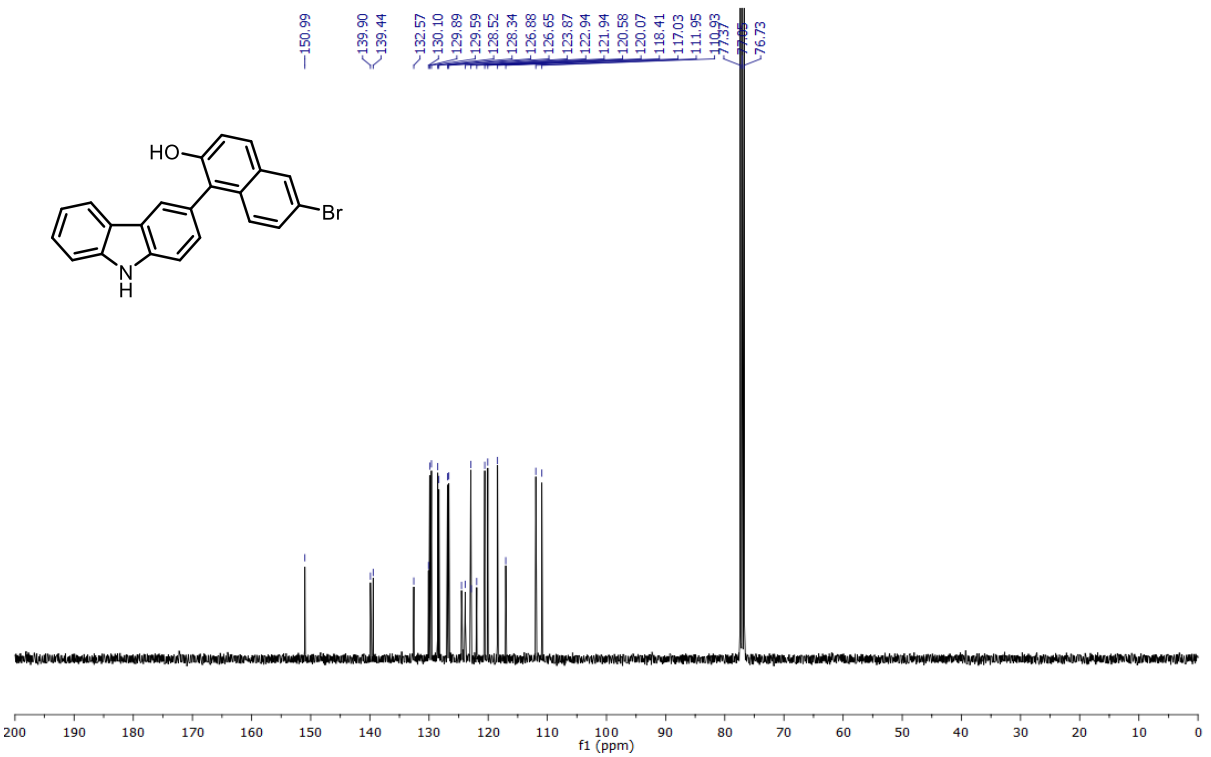


6-Bromo-1-(9*H*-carbazol-3-yl)naphthalen-2-ol (6o)

^{1}H NMR (400 MHz, Chloroform-*d*)

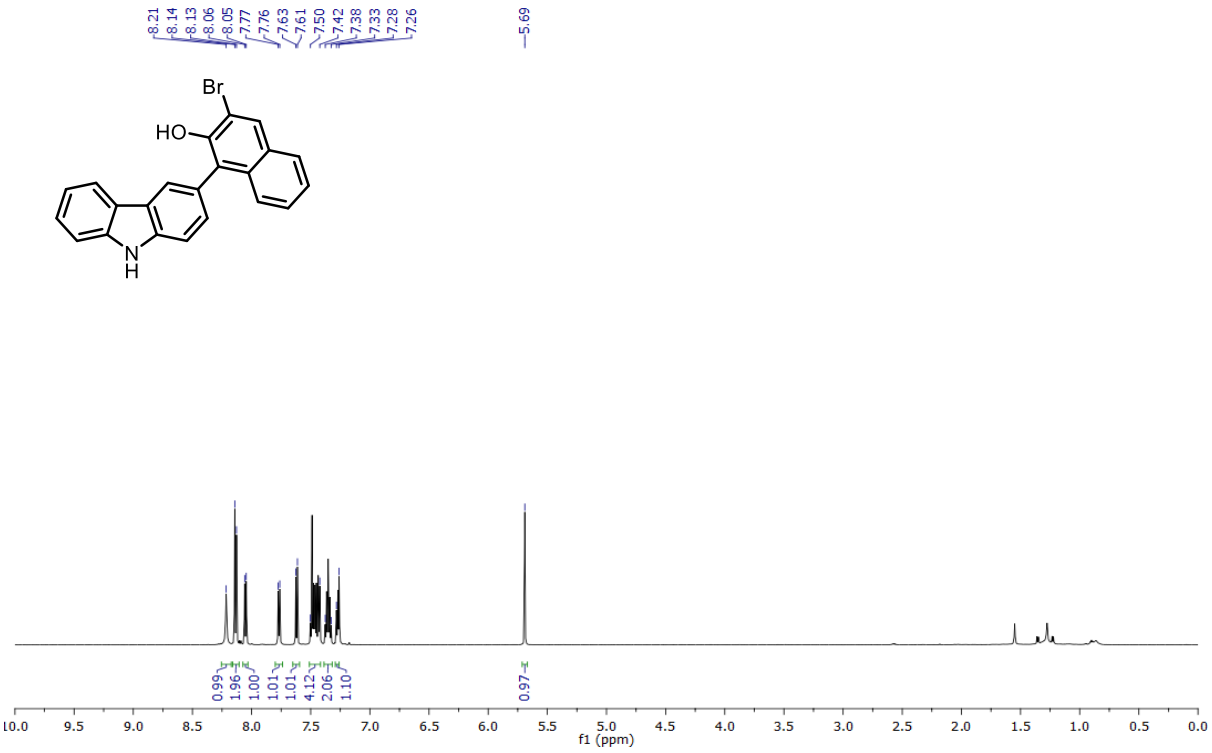


^{13}C NMR (101 MHz, Chloroform-*d*)

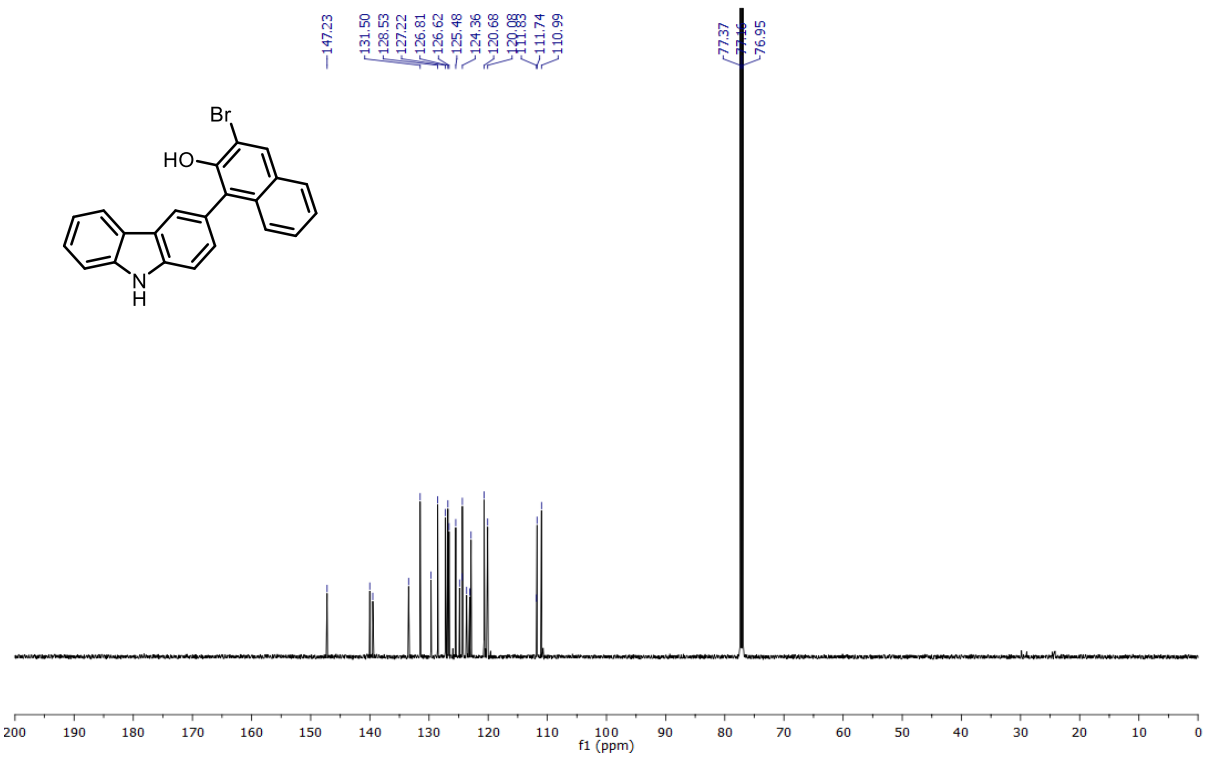


3-Bromo-1-(9*H*-carbazol-3-yl)naphthalen-2-ol (6p)

^{1}H NMR (600 MHz, Chloroform-*d*)

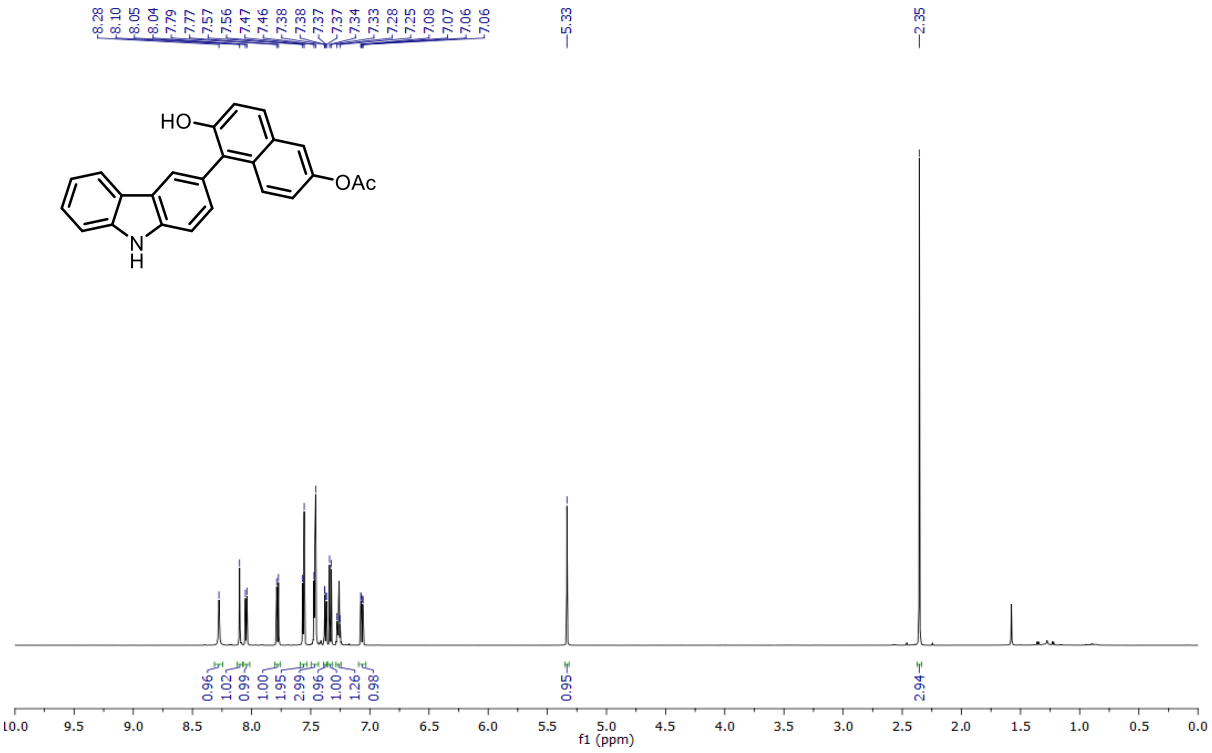


^{13}C NMR (151 MHz, Chloroform-*d*)

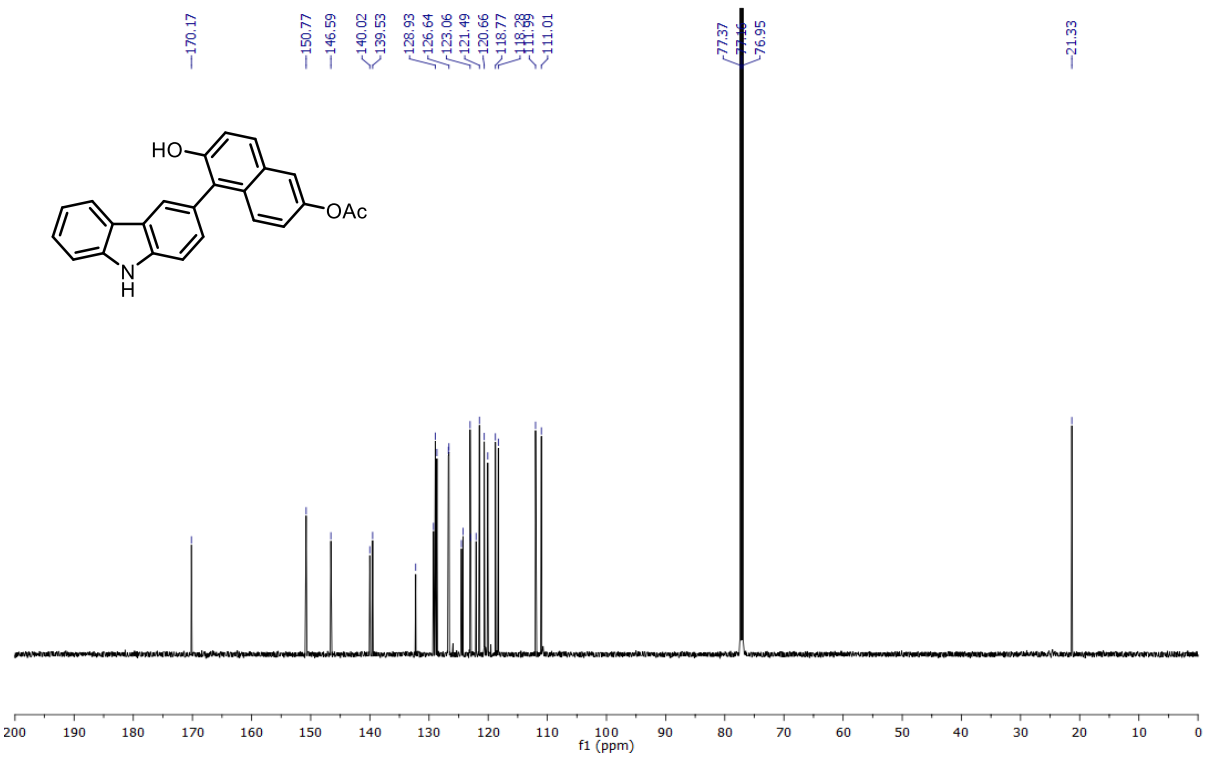


5-(9*H*-Carbazol-3-yl)-6-hydroxynaphthalen-2-yl acetate (6q)

^{1}H NMR (600 MHz, Chloroform-*d*)

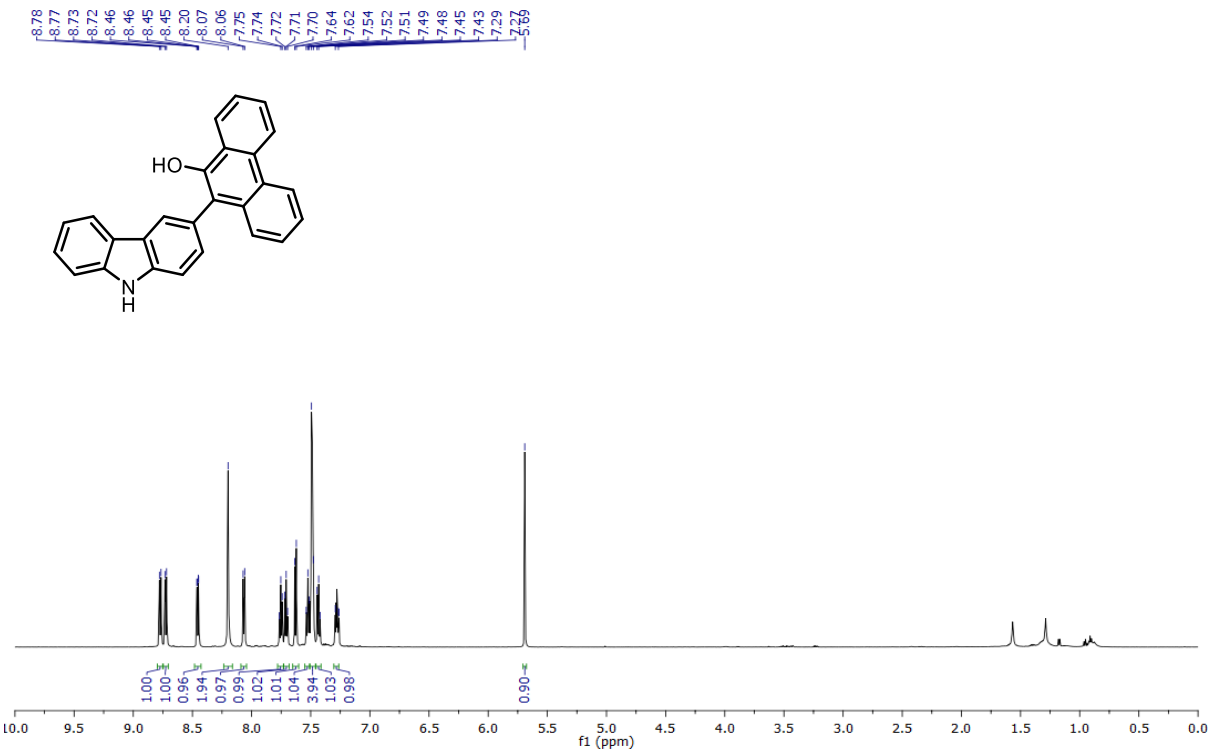


^{13}C NMR (151 MHz, Chloroform-*d*)

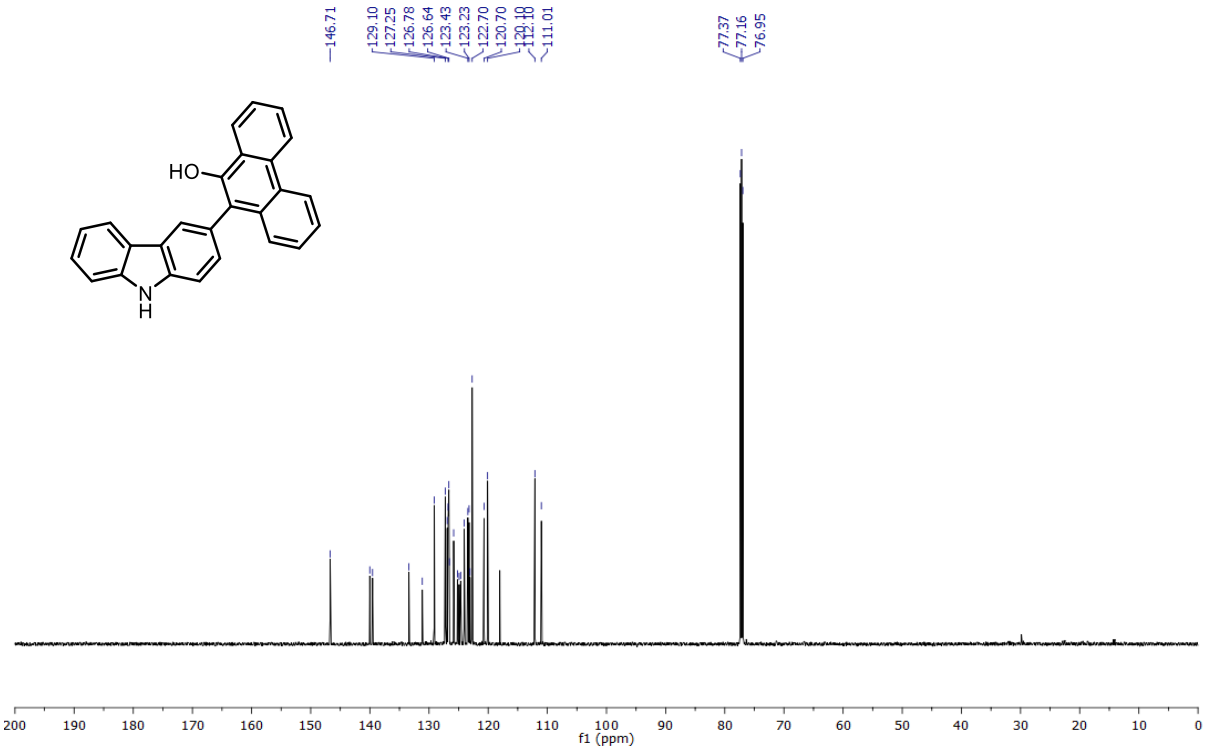


10-(9*H*-Carbazol-3-yl)phenanthren-9-ol (6r)

^{1}H NMR (600 MHz, Chloroform-*d*)

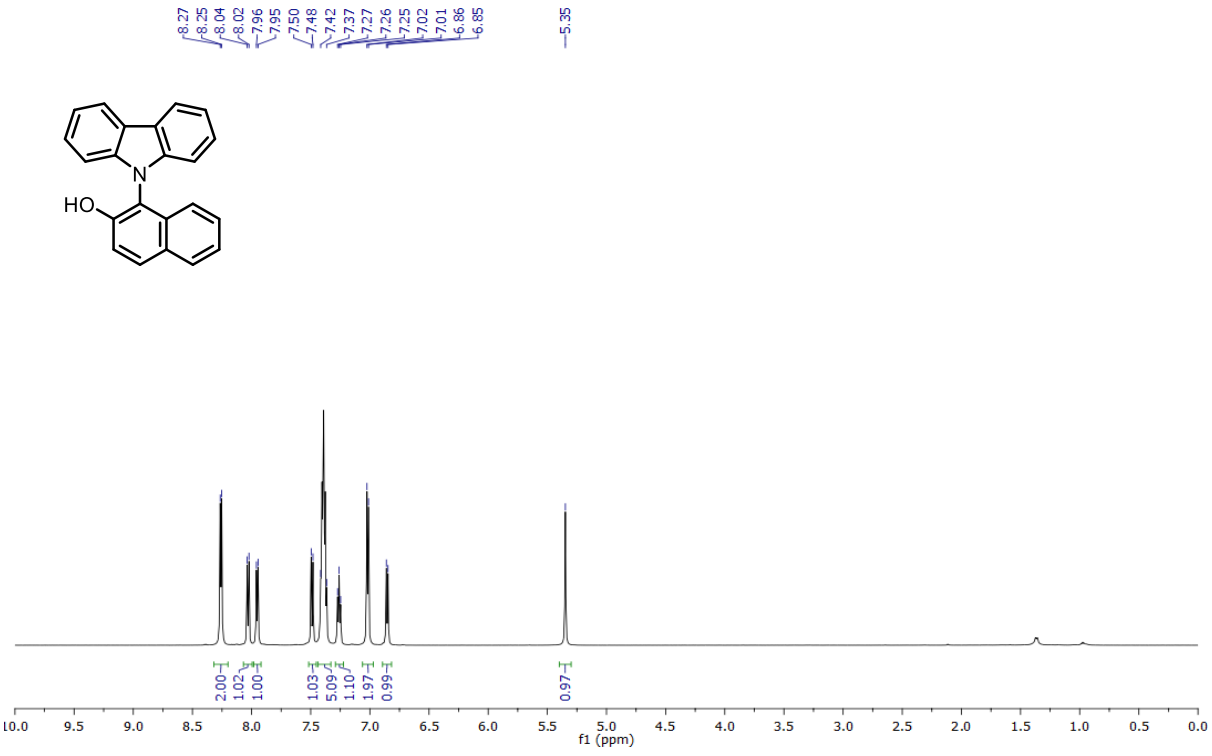


^{13}C NMR (151 MHz, Chloroform-*d*)

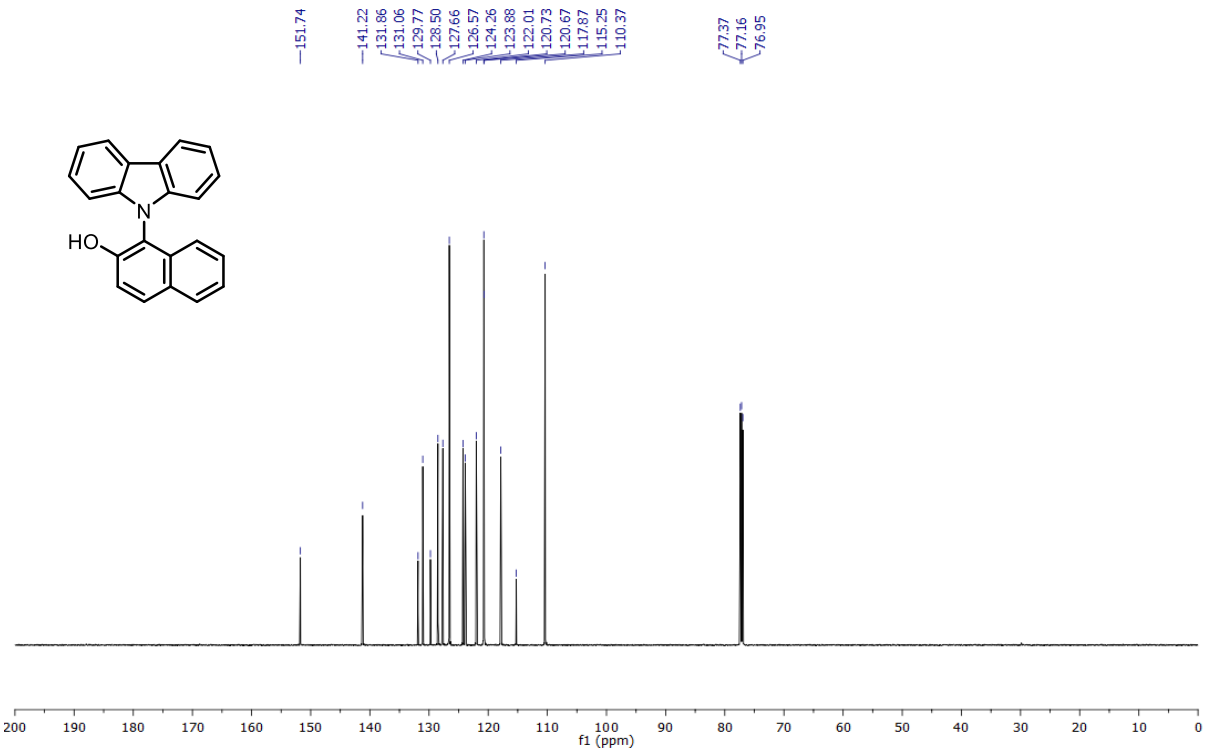


1-(9*H*-Carbazol-9-yl)naphthalen-2-ol (7a)

^{1}H NMR (600 MHz, Chloroform-*d*)

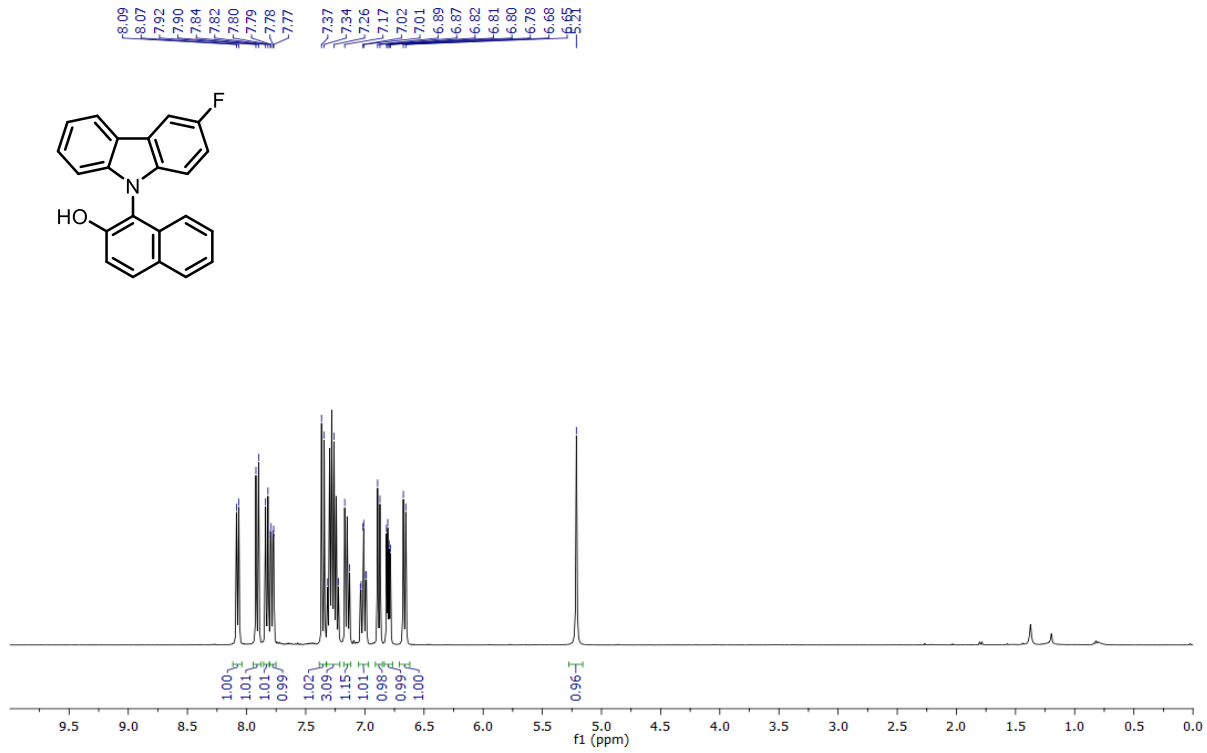


^{13}C NMR (151 MHz, Chloroform-*d*)

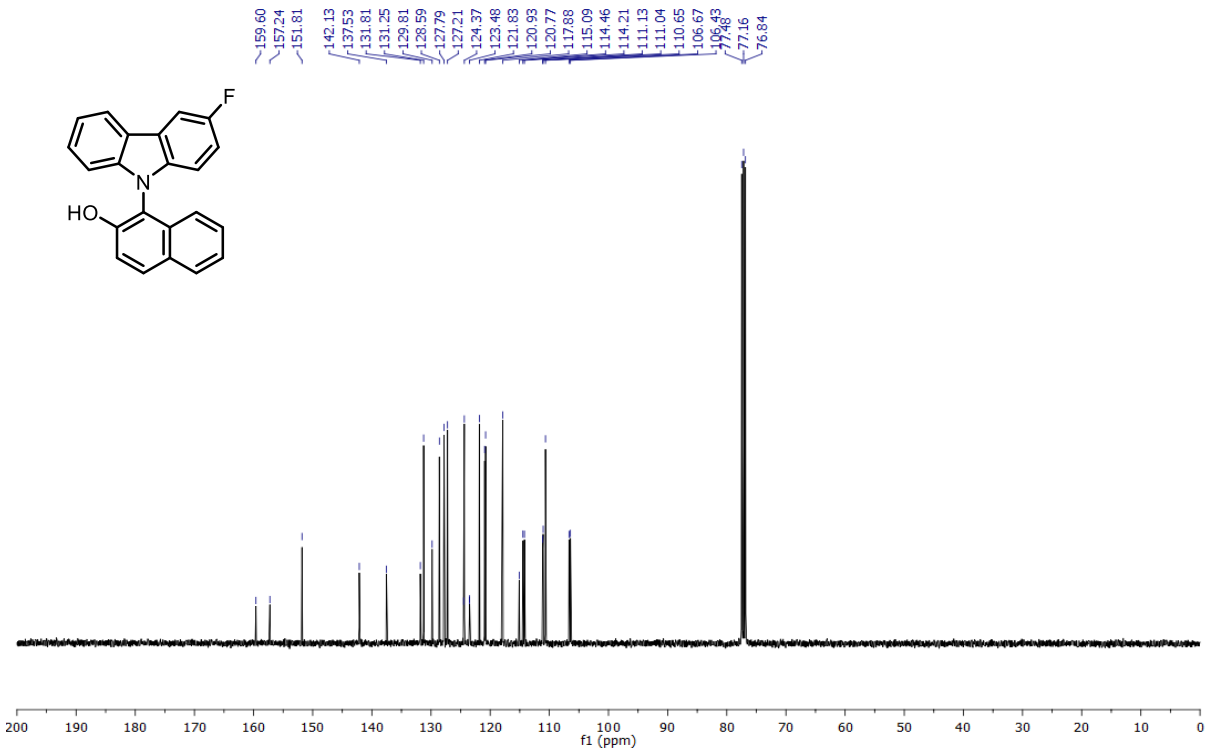


11-(3-Fluoro-9*H*-carbazol-9-yl)naphthalen-2-ol (7b)

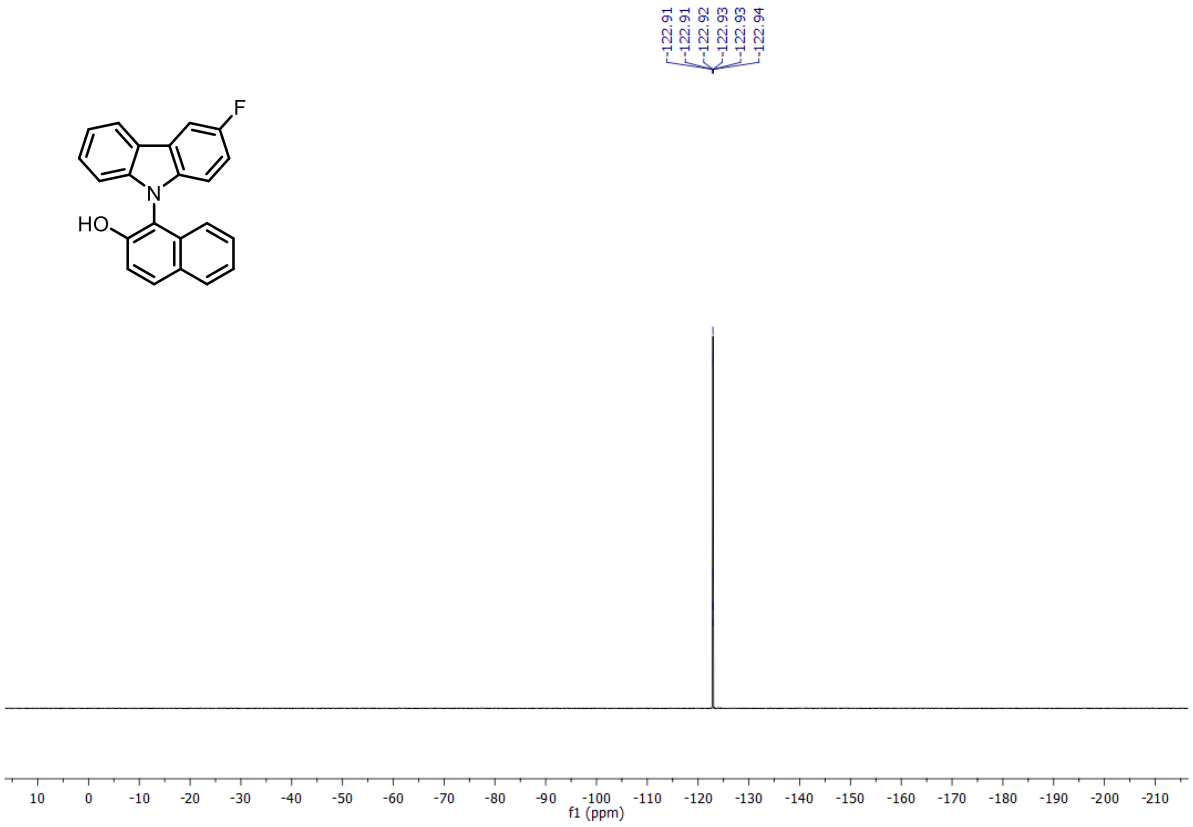
^{1}H NMR (400 MHz, Chloroform-*d*)



^{13}C NMR (101 MHz, Chloroform-*d*)

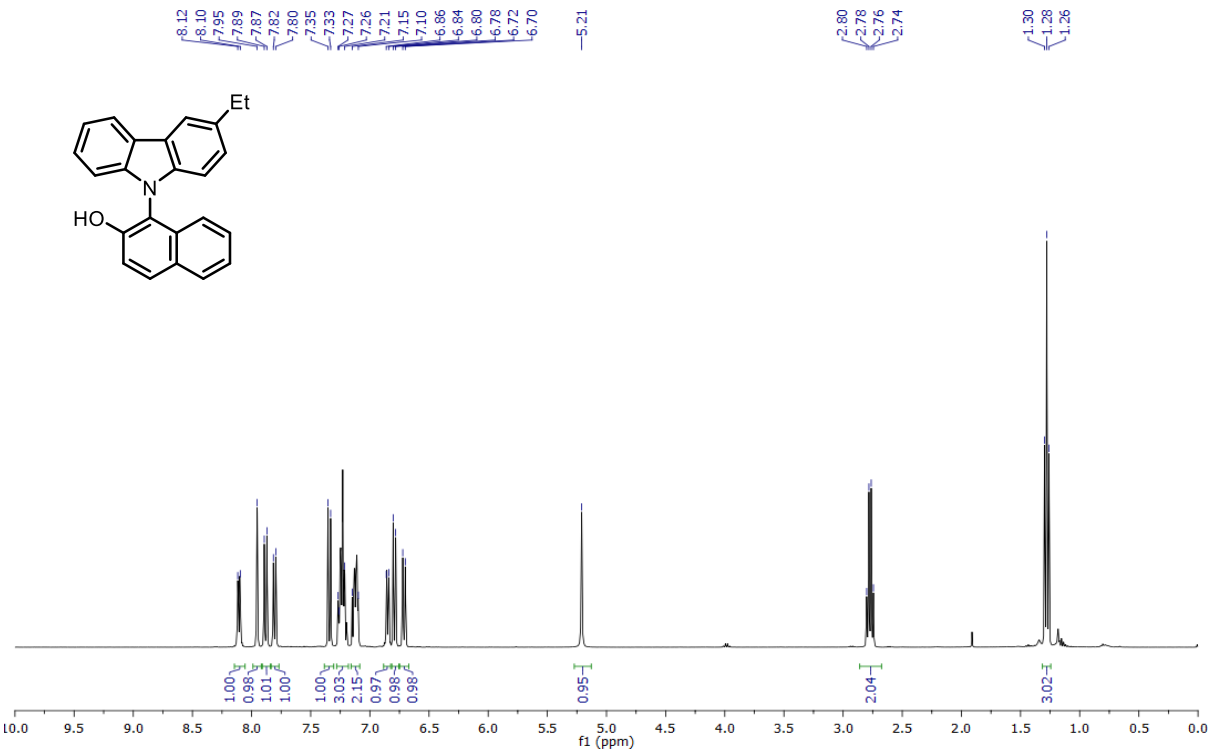


^{19}F NMR (565 MHz, Chloroform-*d*)

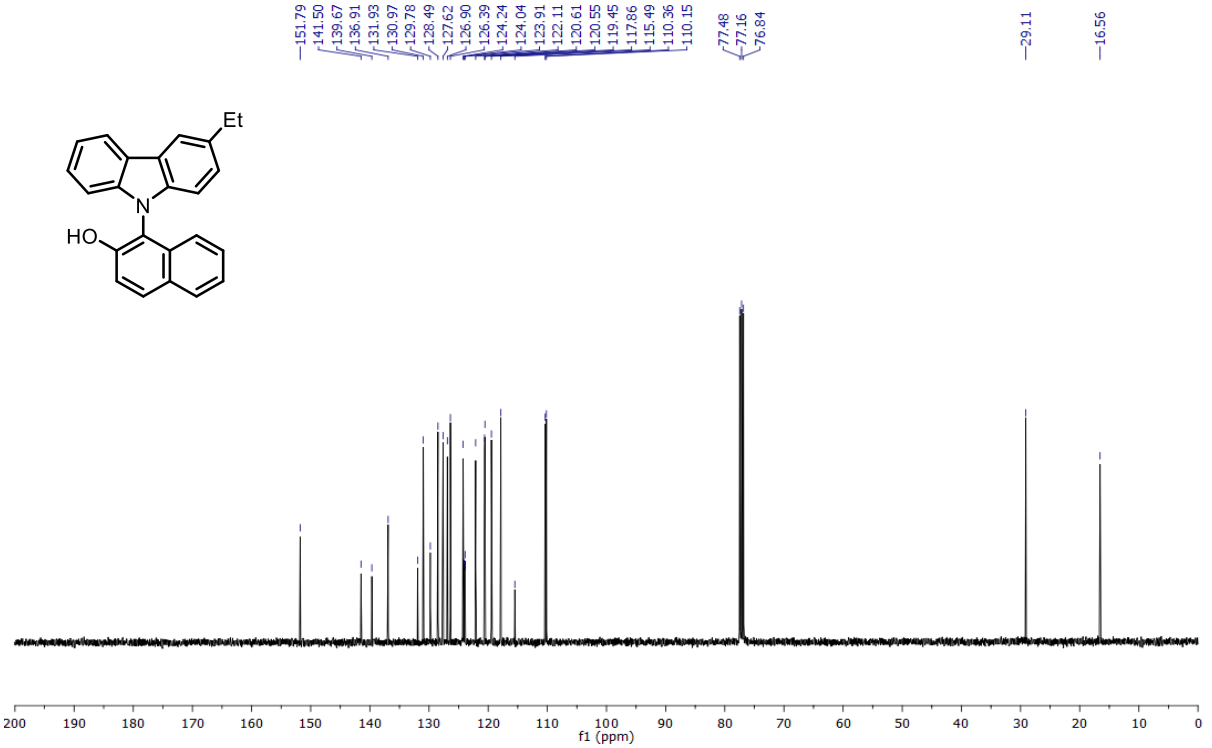


1-(3-Ethyl-9*H*-carbazol-9-yl)naphthalen-2-ol (7c)

^{1}H NMR (400 MHz, Chloroform-*d*)

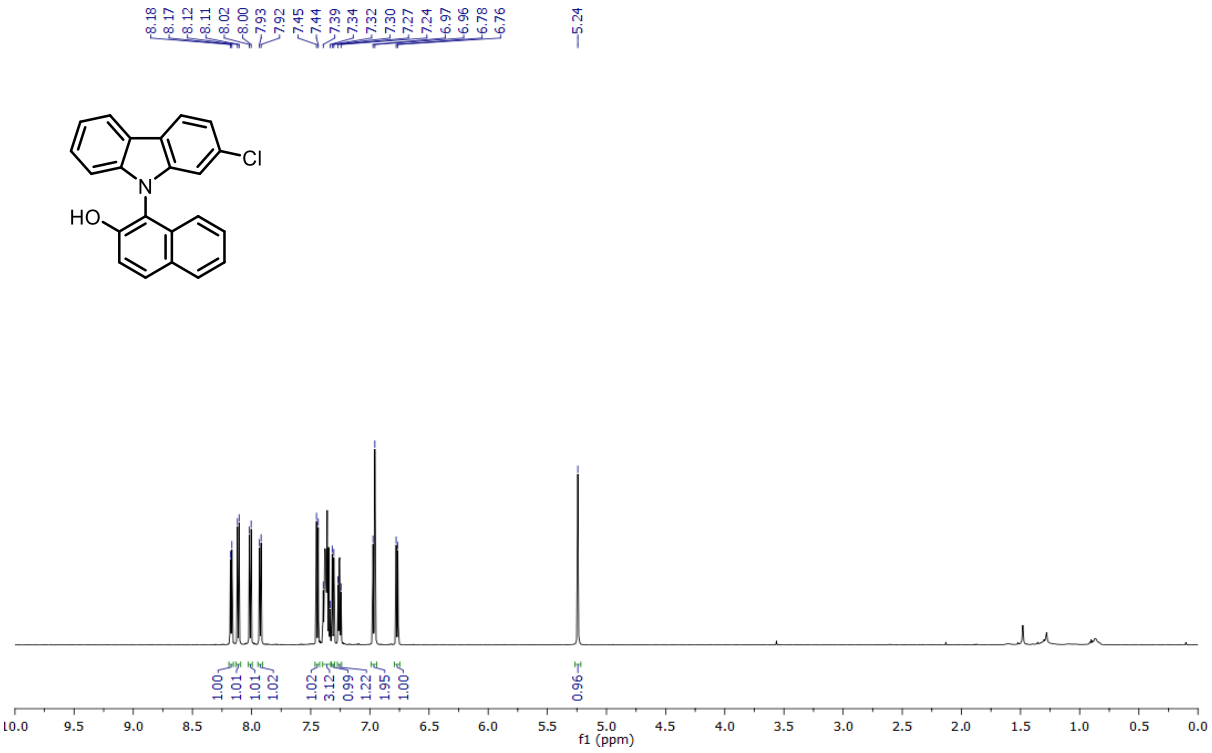


^{13}C NMR (101 MHz, Chloroform-*d*)

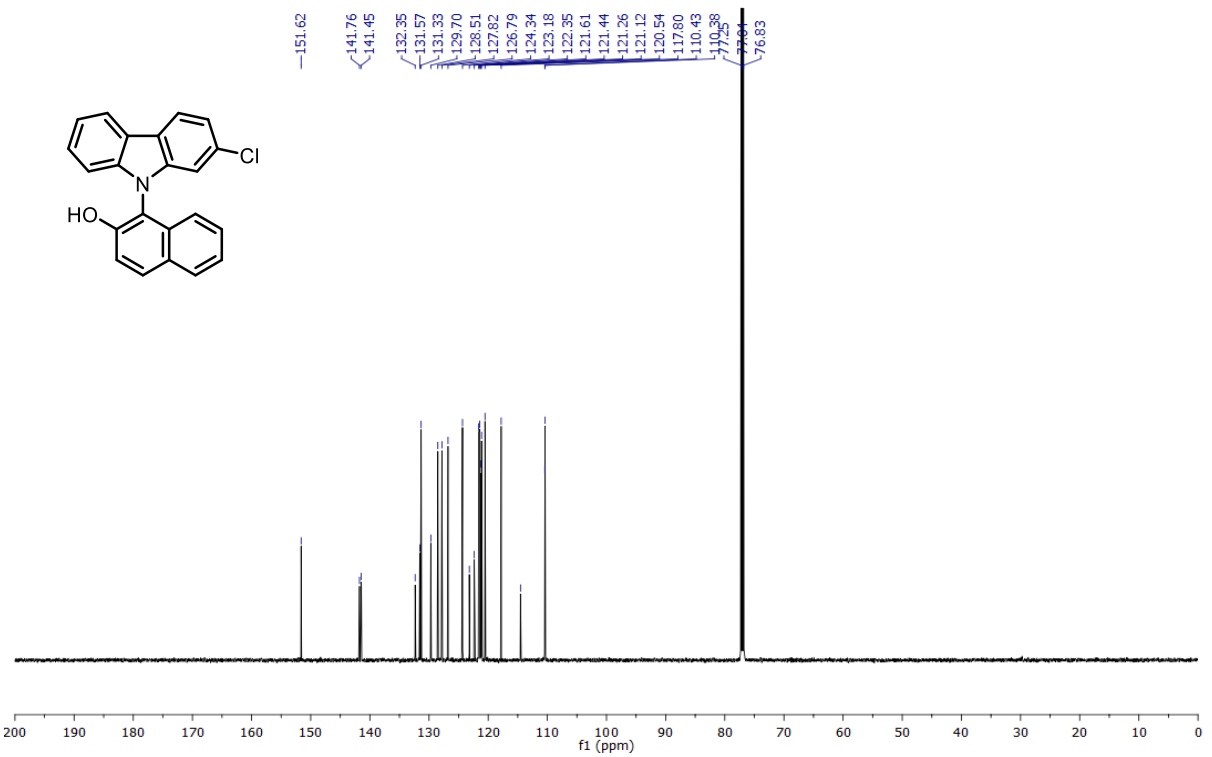


1-(2-Chloro-9*H*-carbazol-9-yl)naphthalen-2-ol (7d)

^{1}H NMR (600 MHz, Chloroform-*d*)

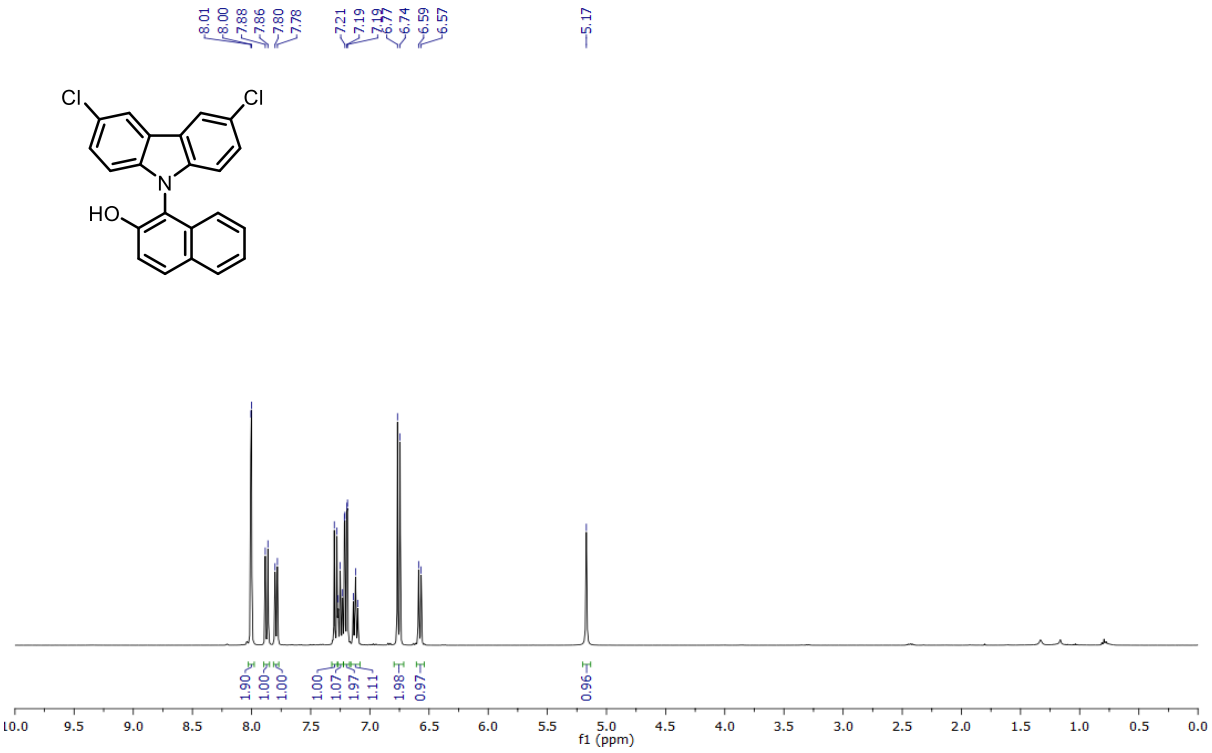


^{13}C NMR (151 MHz, Chloroform-*d*)

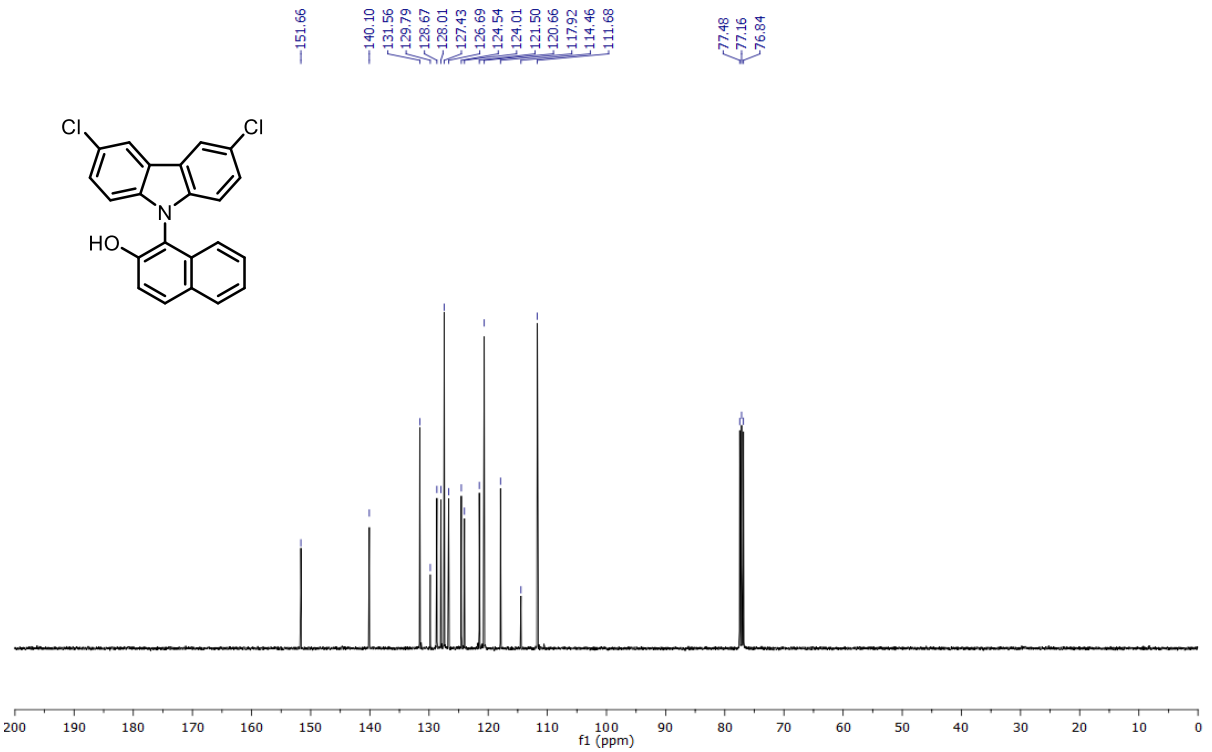


1-(3,6-Dichloro-9*H*-carbazol-9-yl)naphthalen-2-ol (7e)

^{1}H NMR (400 MHz, Chloroform-*d*)

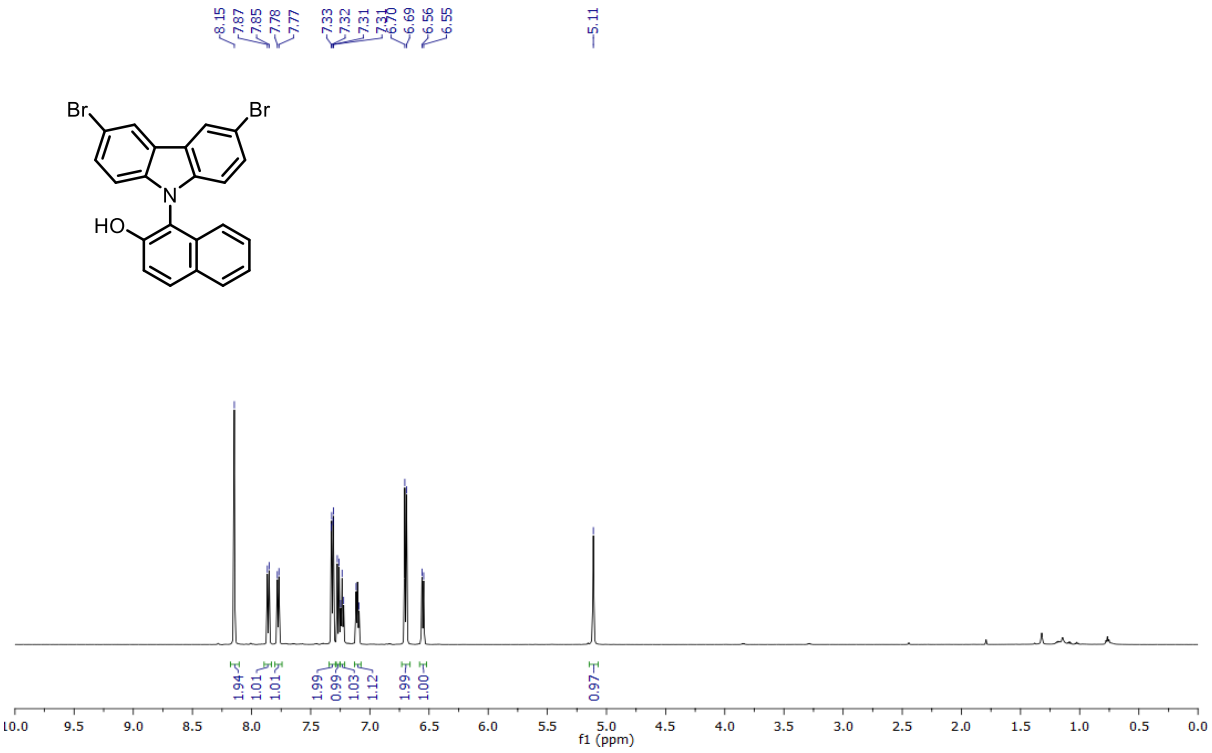


^{13}C NMR (101 MHz, Chloroform-*d*)

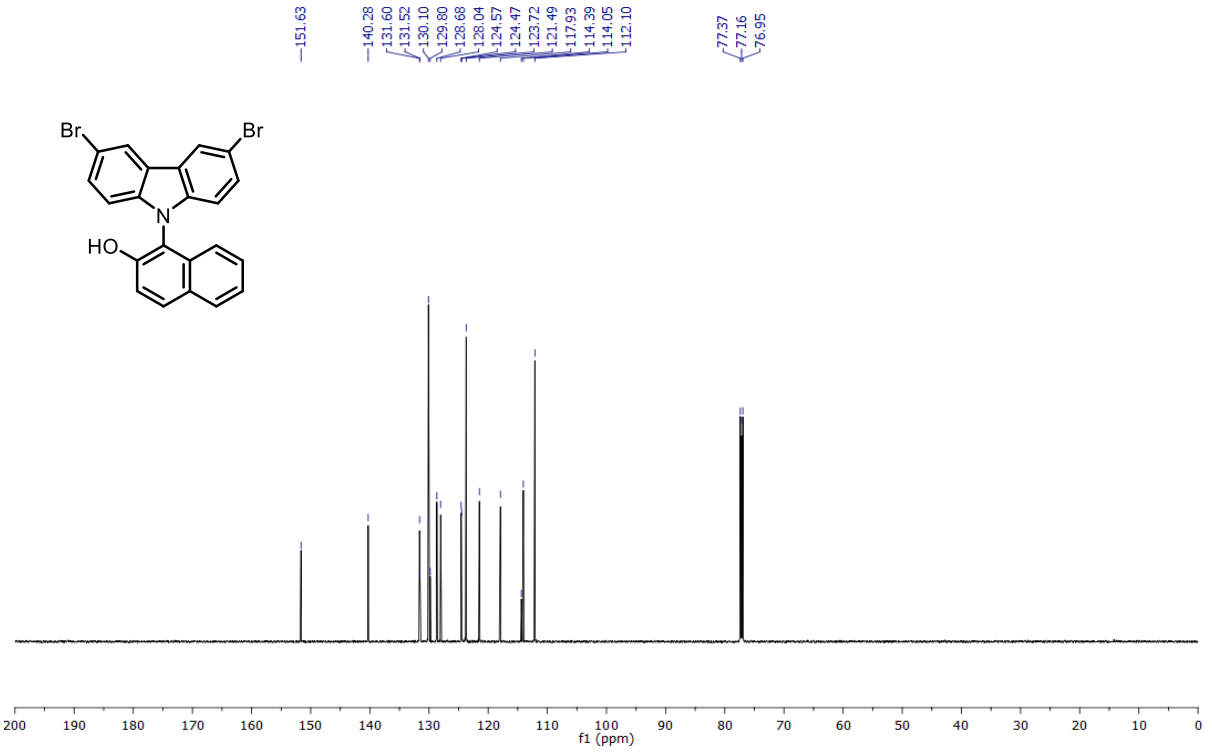


1-(3,6-Dibromo-9*H*-carbazol-9-yl)naphthalen-2-ol (7f)

^{1}H NMR (600 MHz, Chloroform-*d*)

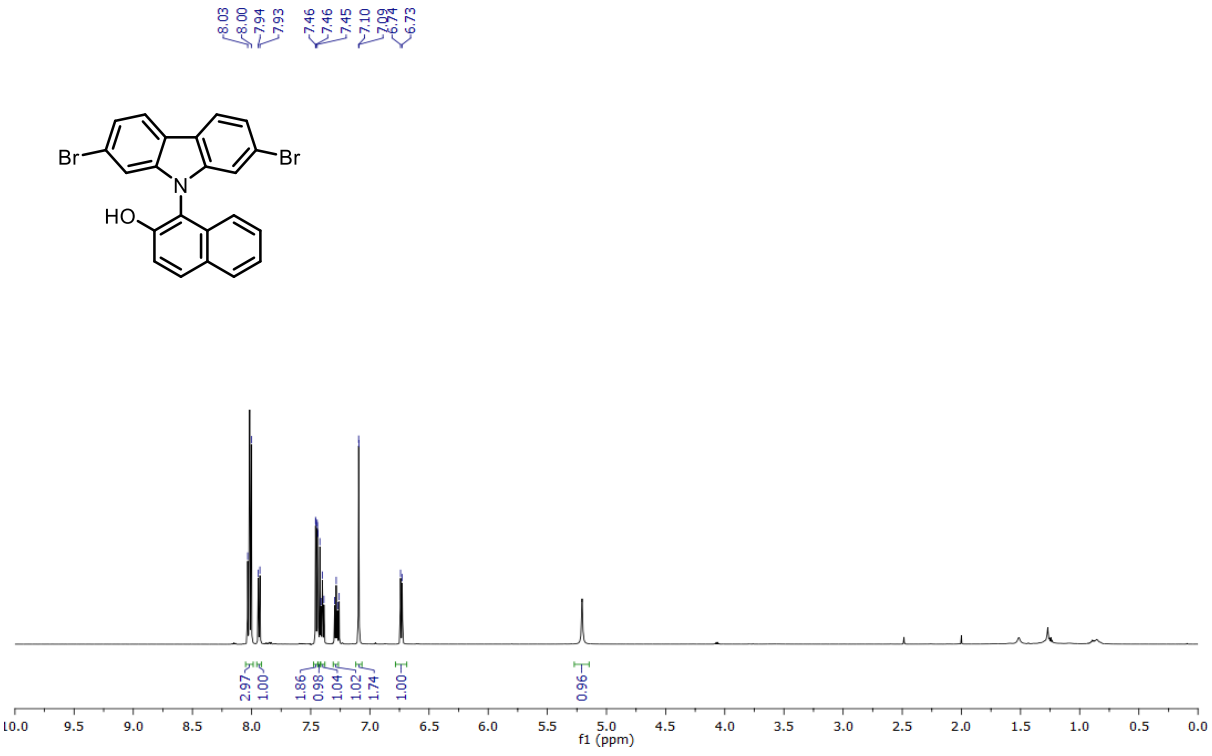


^{13}C NMR (151 MHz, Chloroform-*d*)

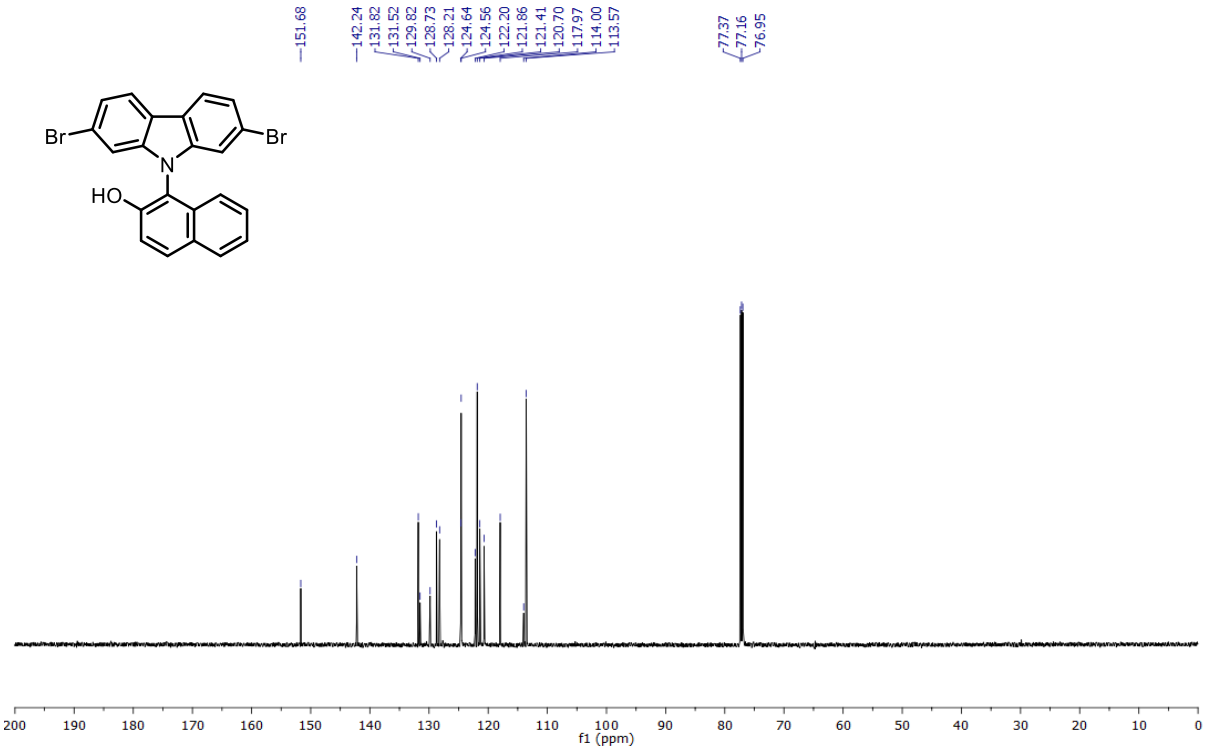


1-(2,7-Dibromo-9*H*-carbazol-9-yl)naphthalen-2-ol (7g)

^{1}H NMR (600 MHz, Chloroform-*d*)

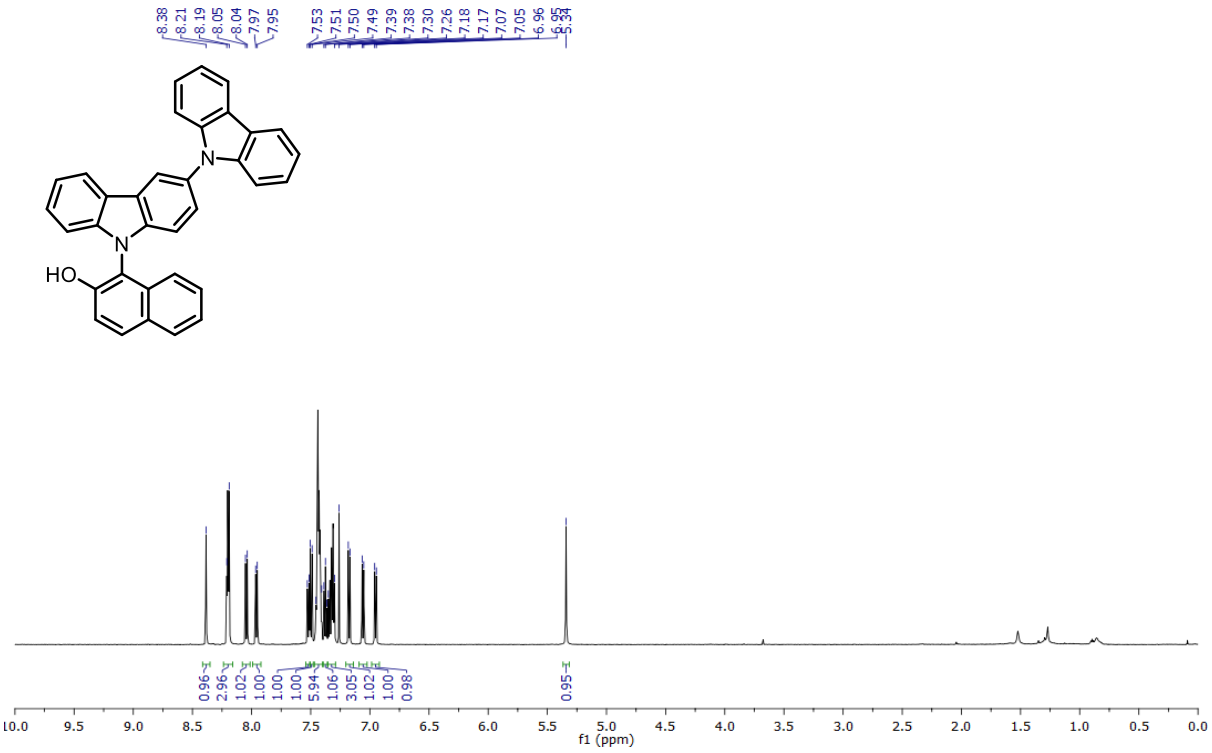


^{13}C NMR (151 MHz, Chloroform-*d*)

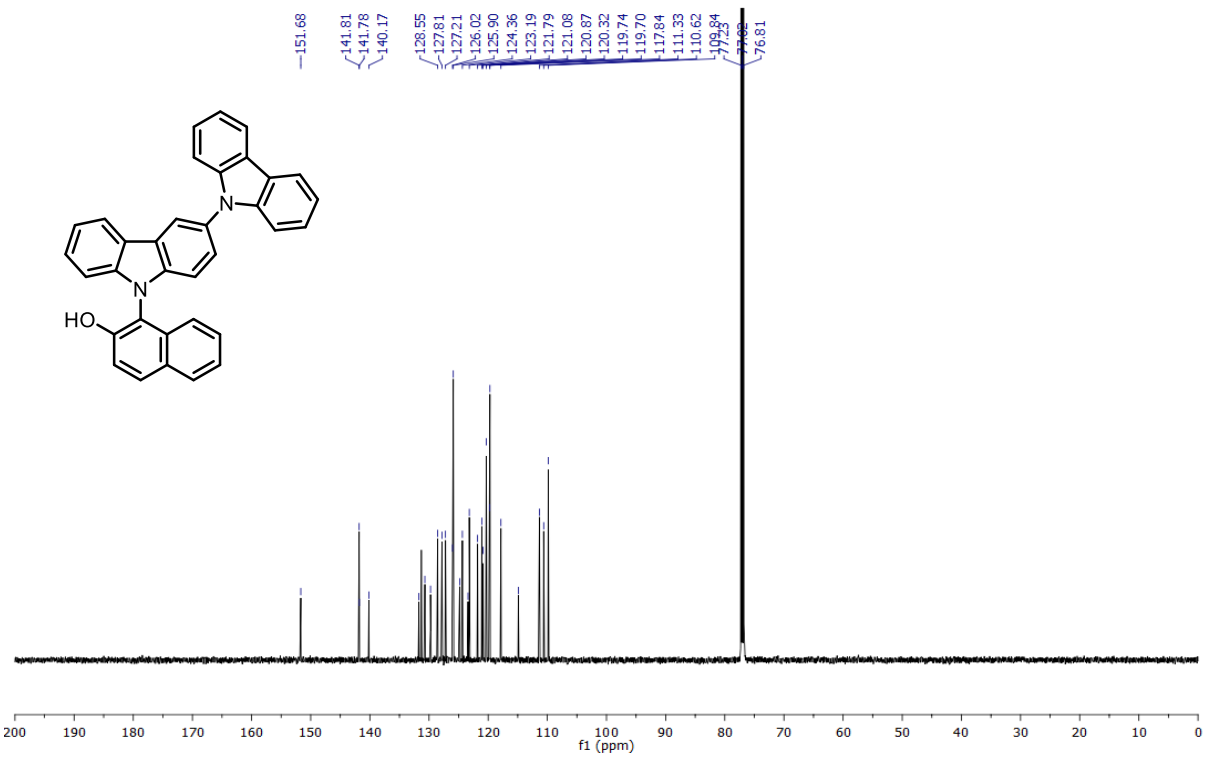


1-(9*H*-[3,9'-Bicarbazol]-9-yl)naphthalen-2-ol (7h)

^{1}H NMR (600 MHz, Chloroform-*d*)

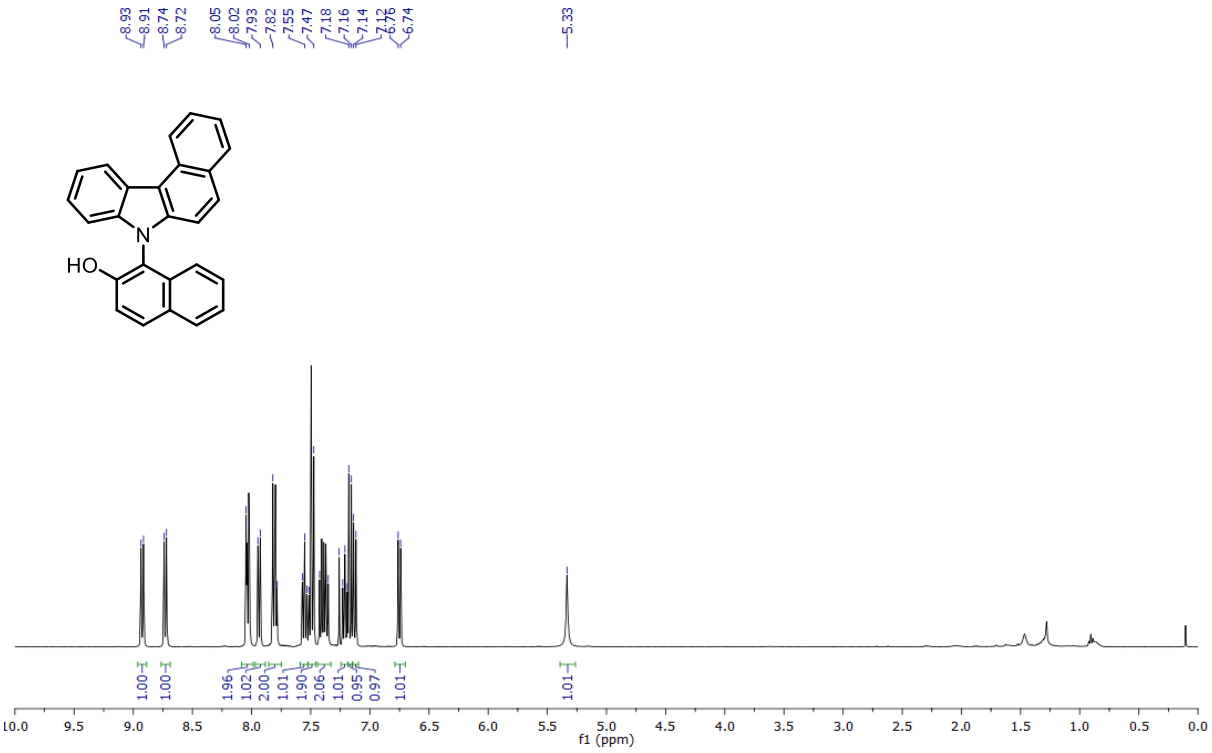


^{13}C NMR (151 MHz, Chloroform-*d*)

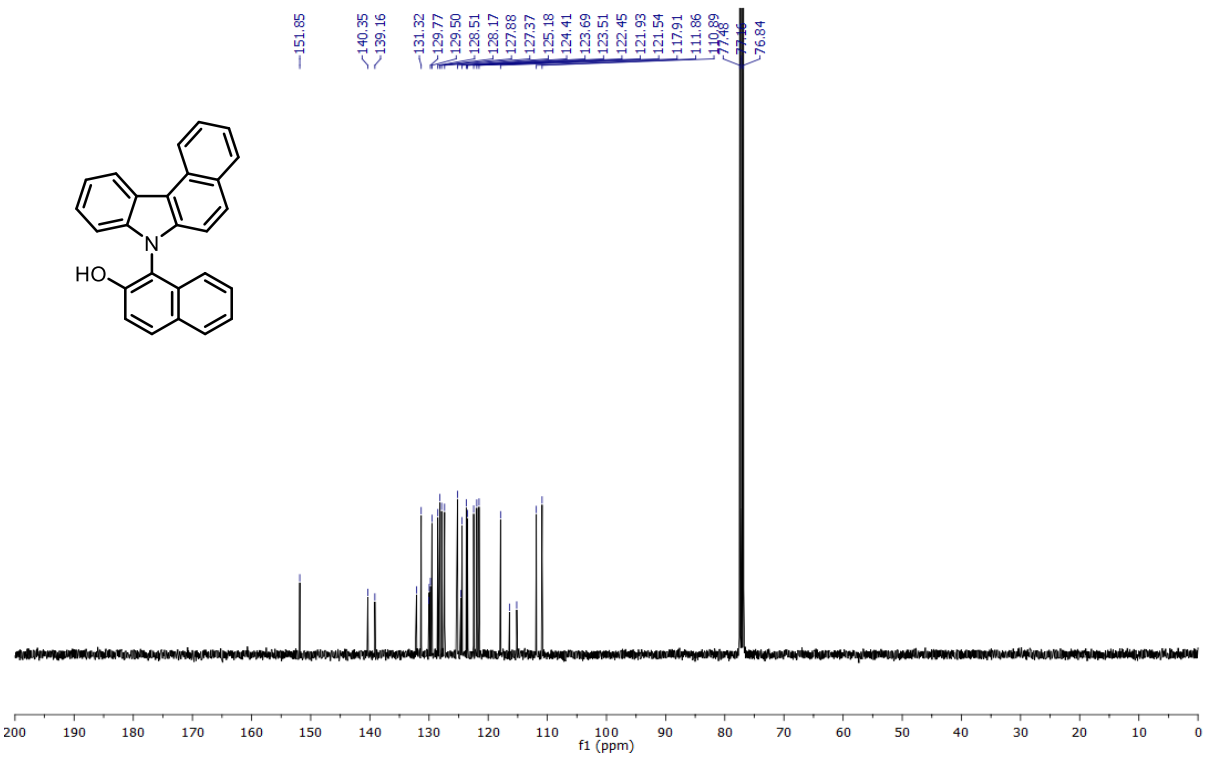


1-(7*H*-Benzo[*c*]carbazol-7-yl)naphthalen-2-ol (7i)

^{1}H NMR (400 MHz, Chloroform-*d*)

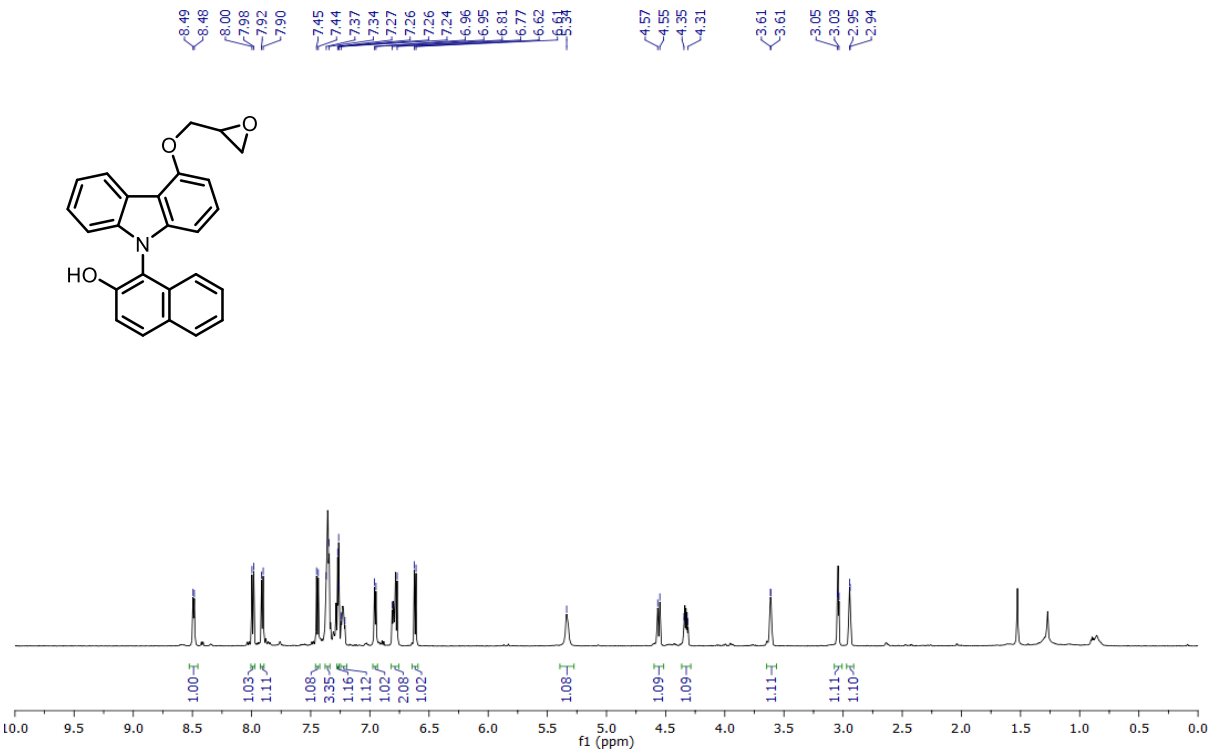


^{13}C NMR (101 MHz, Chloroform-*d*)

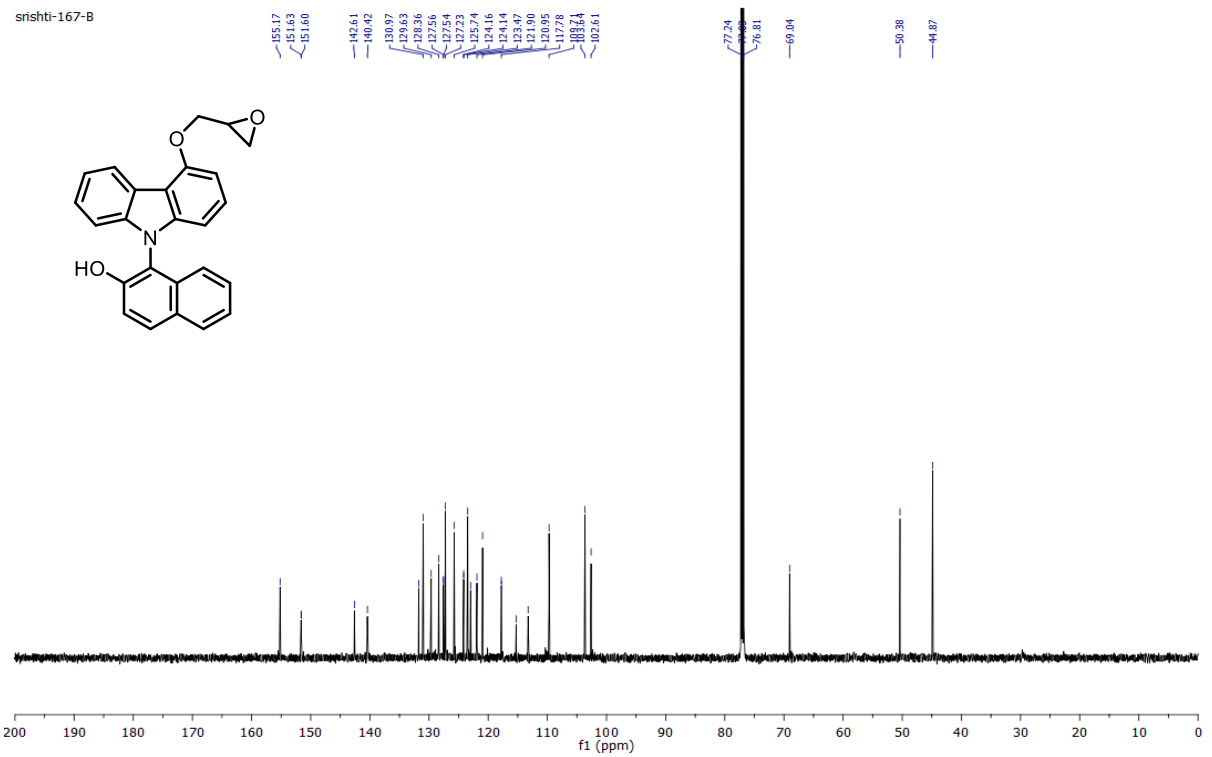


1-(4-(Oxiran-2-ylmethoxy)-9*H*-carbazol-9-yl)naphthalen-2-ol (7j)

^{1}H NMR (600 MHz, Chloroform-*d*)

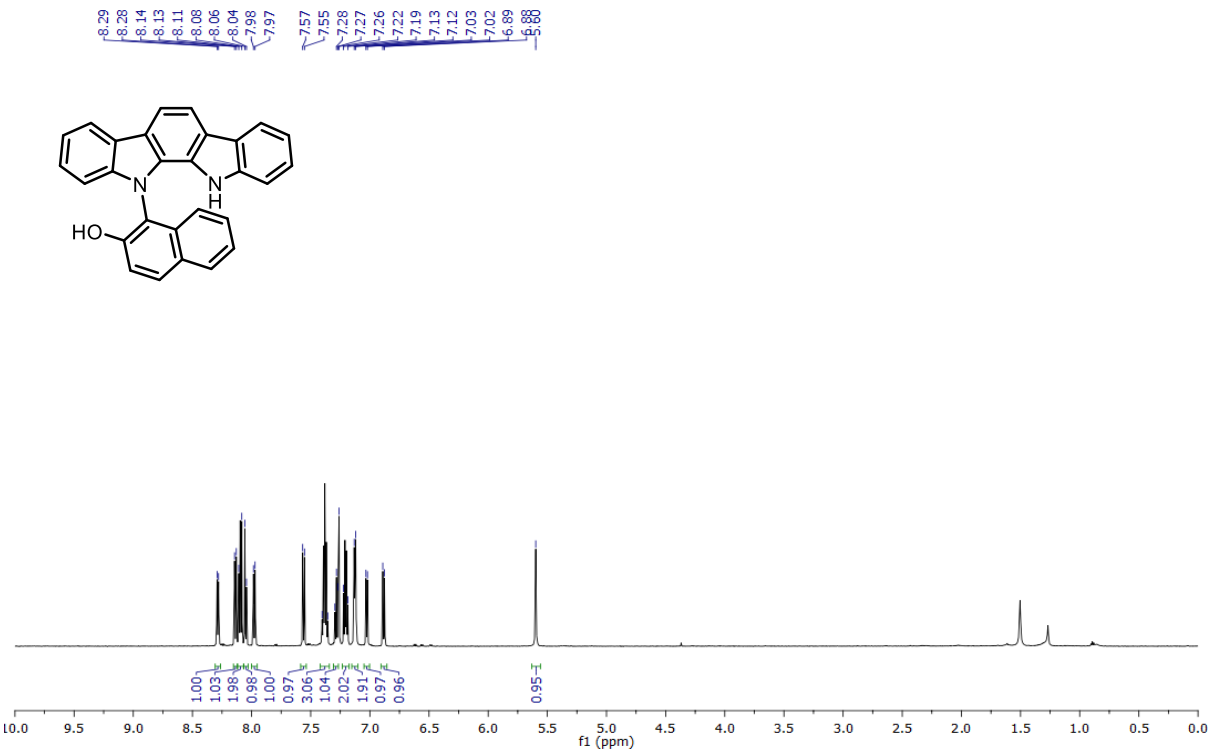


^{13}C NMR (151 MHz, Chloroform-*d*)

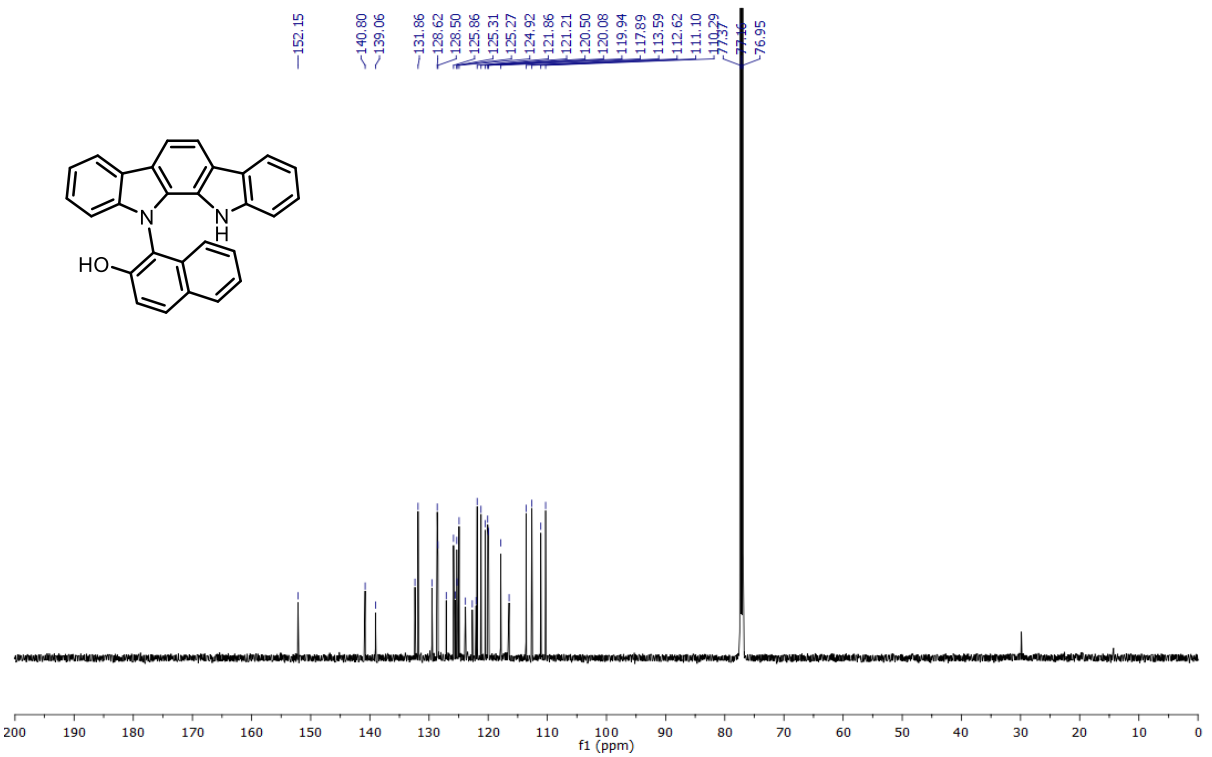


8-(Indolo[2,3-*a*]carbazol-11(12*H*)-yl)naphthalen-2-ol (7k)

^{1}H NMR (600 MHz, Chloroform-*d*)

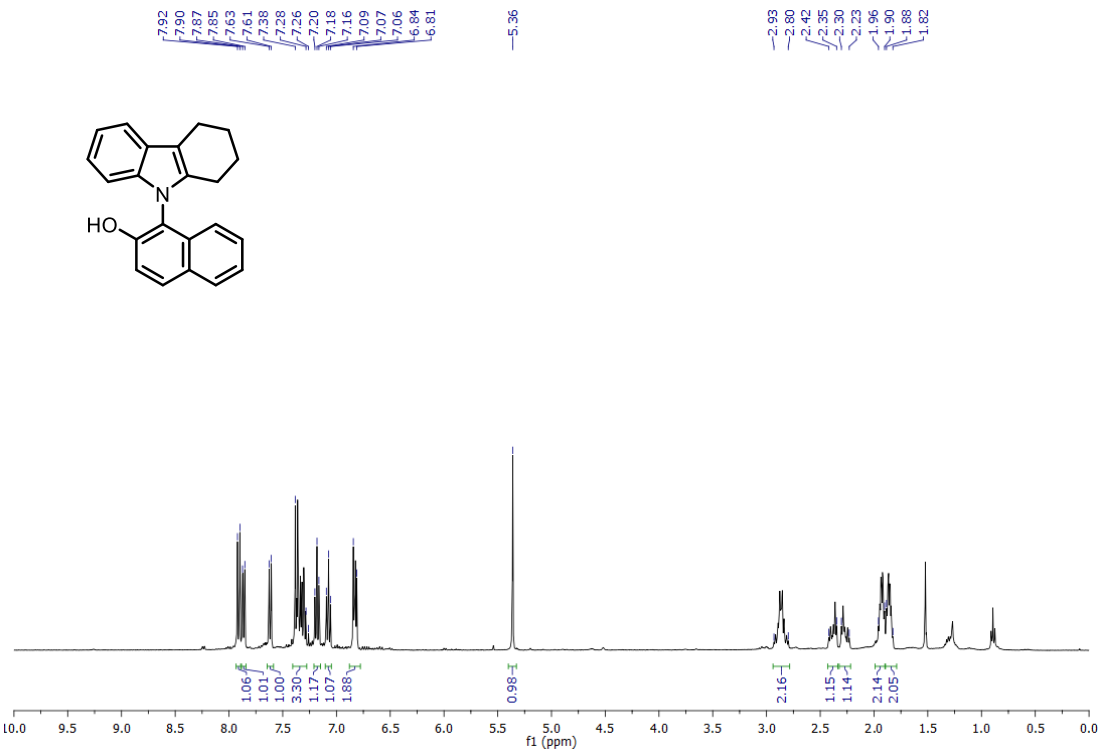


^{13}C NMR (151 MHz, Chloroform-*d*)

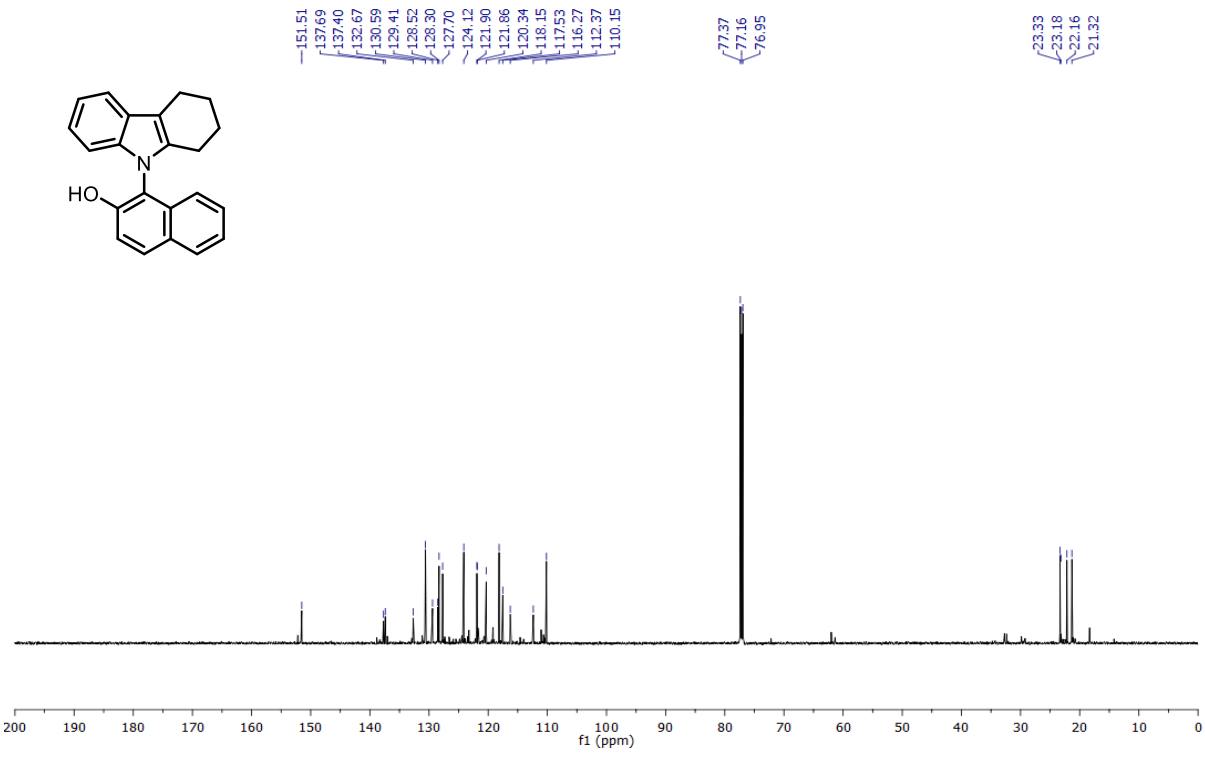


1-(1,2,3,4-Tetrahydro-9*H*-carbazol-9-yl)naphthalen-2-ol (7l)

^{1}H NMR (400 MHz, Chloroform-*d*)

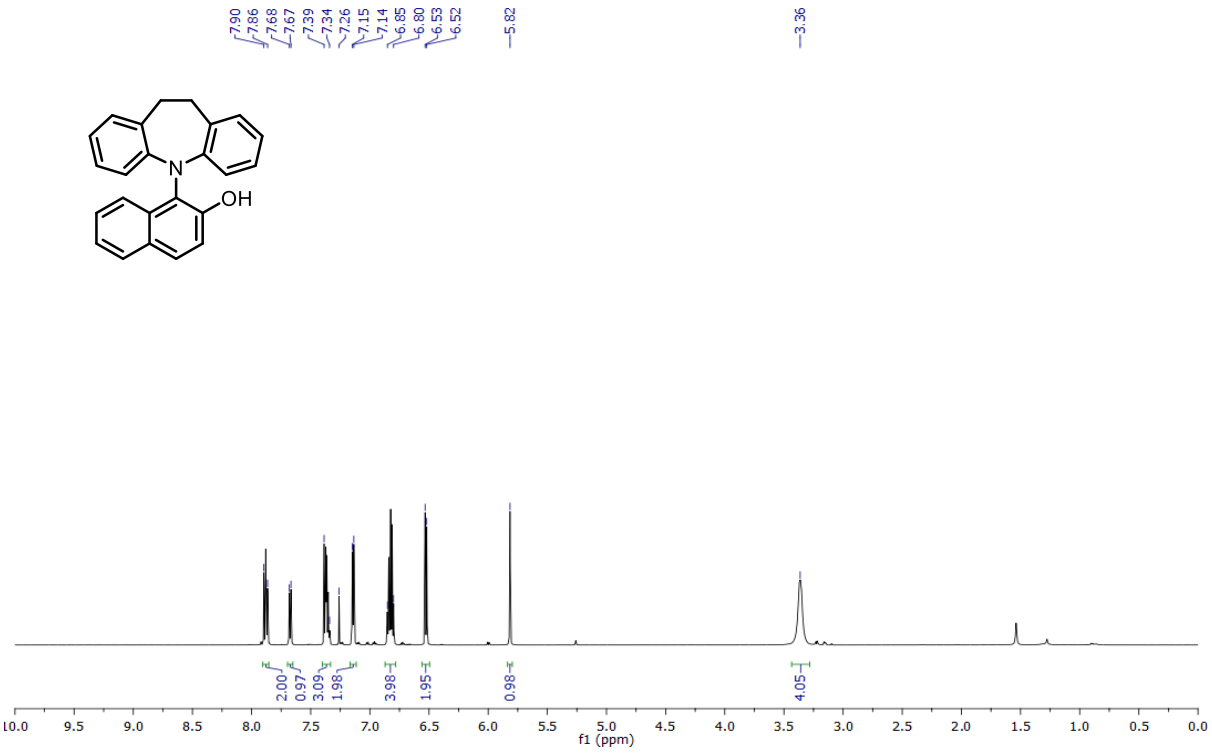


^{13}C NMR (151 MHz, Chloroform-*d*)

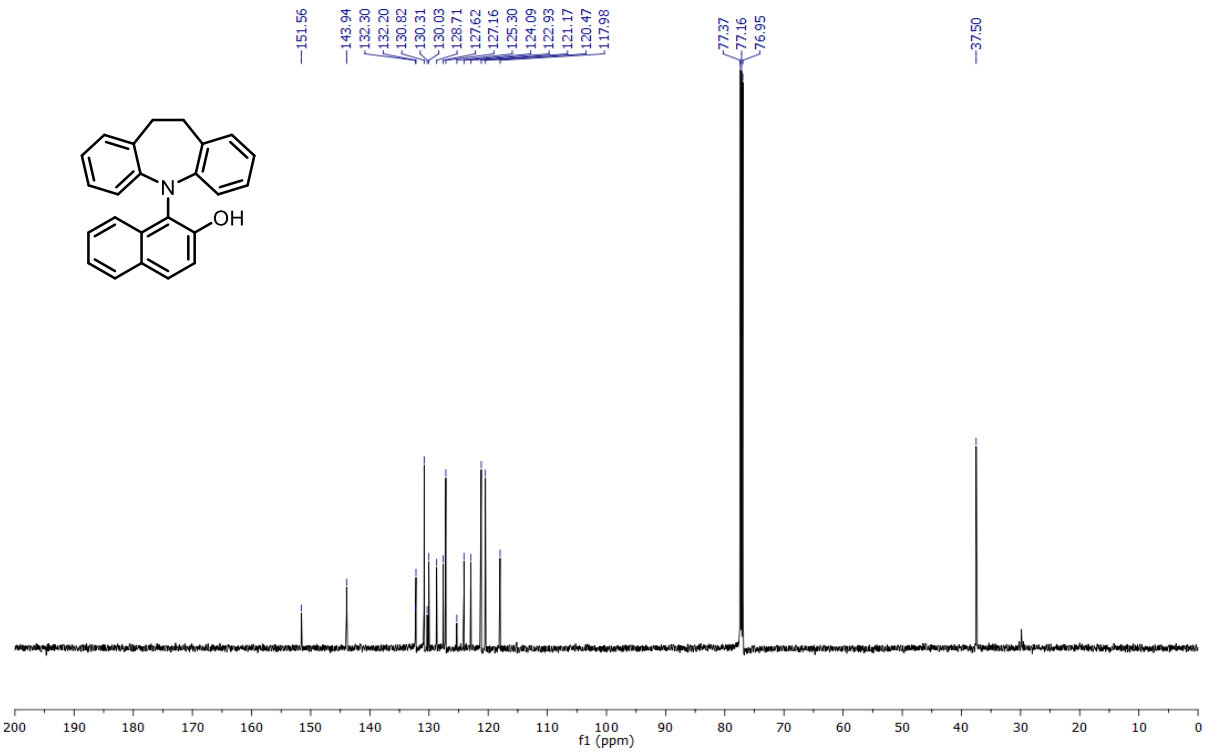


1-(10,11-Dihydro-5*H*-dibenzo[*b*,*f*]azepin-5-yl)naphthalen-2-ol (7m)

^{1}H NMR (600 MHz, Chloroform-*d*)

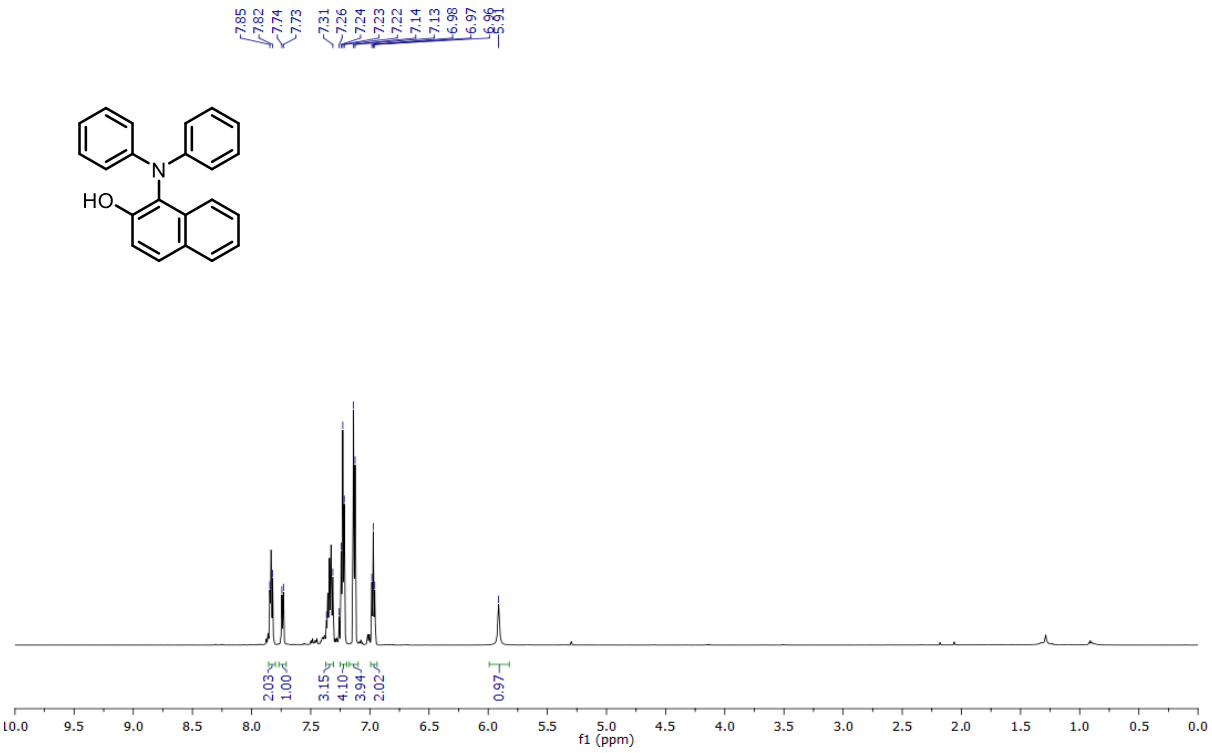


^{13}C NMR (151 MHz, Chloroform-*d*)

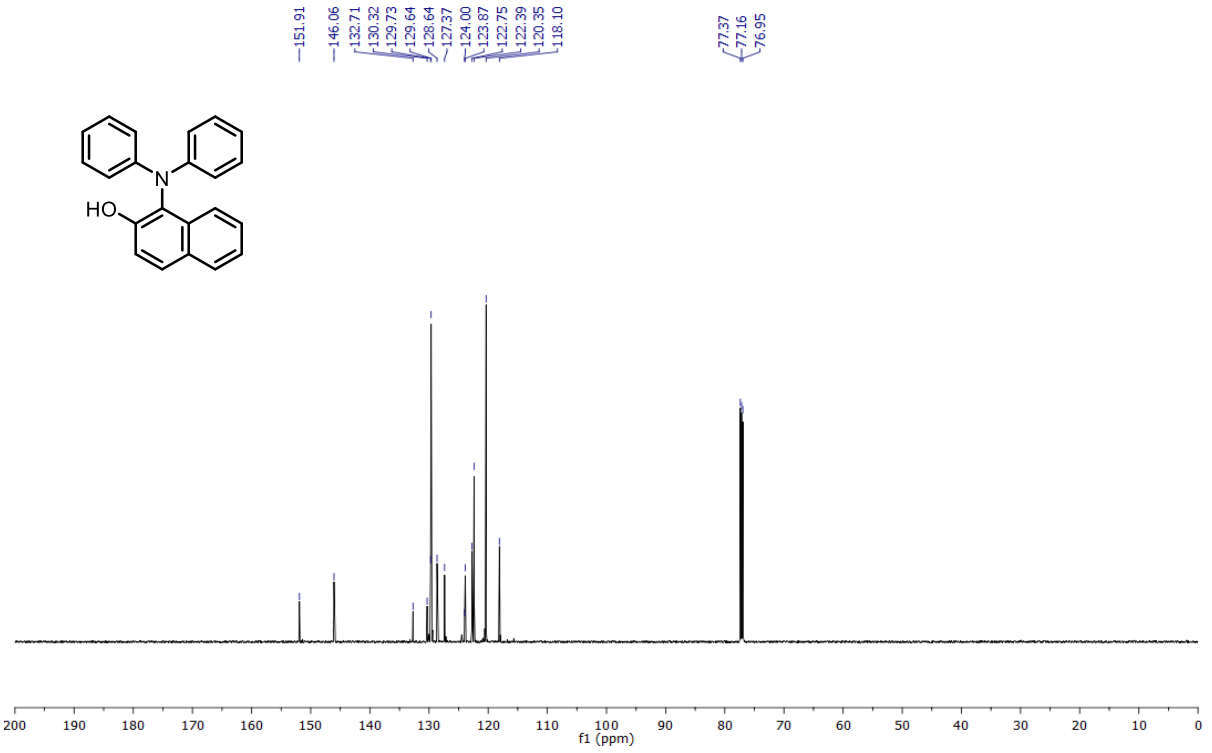


1-(Diphenylamino)naphthalen-2-ol (7n)

^{1}H NMR (600 MHz, Chloroform-*d*)

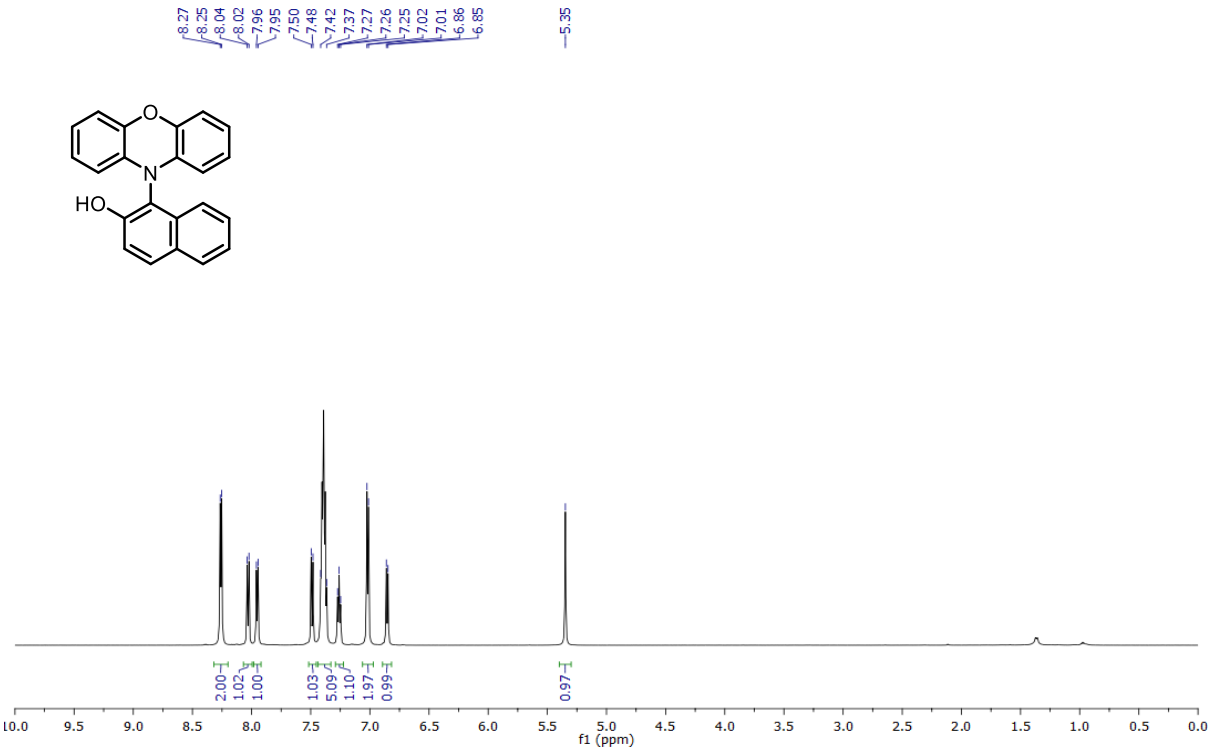


^{13}C NMR (151 MHz, Chloroform-*d*)

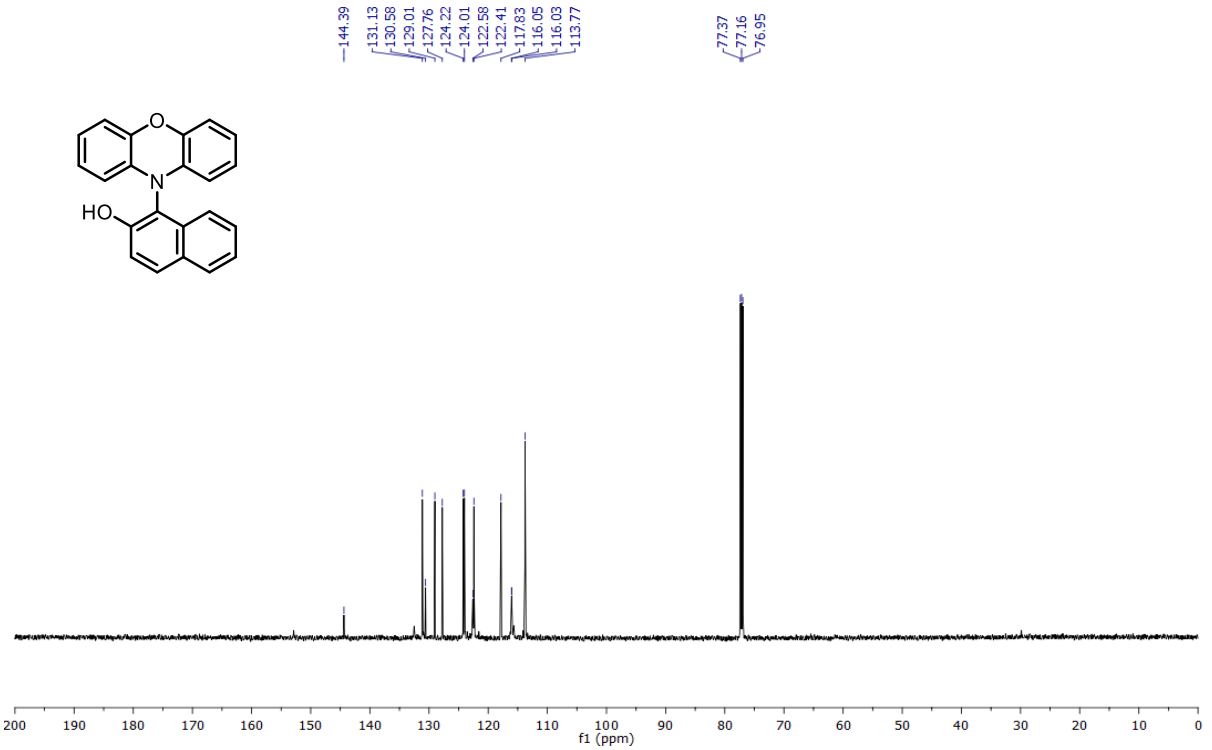


1-(10*H*-Phenoxazin-10-yl)naphthalen-2-ol (7o)

^{1}H NMR (600 MHz, Chloroform-*d*)

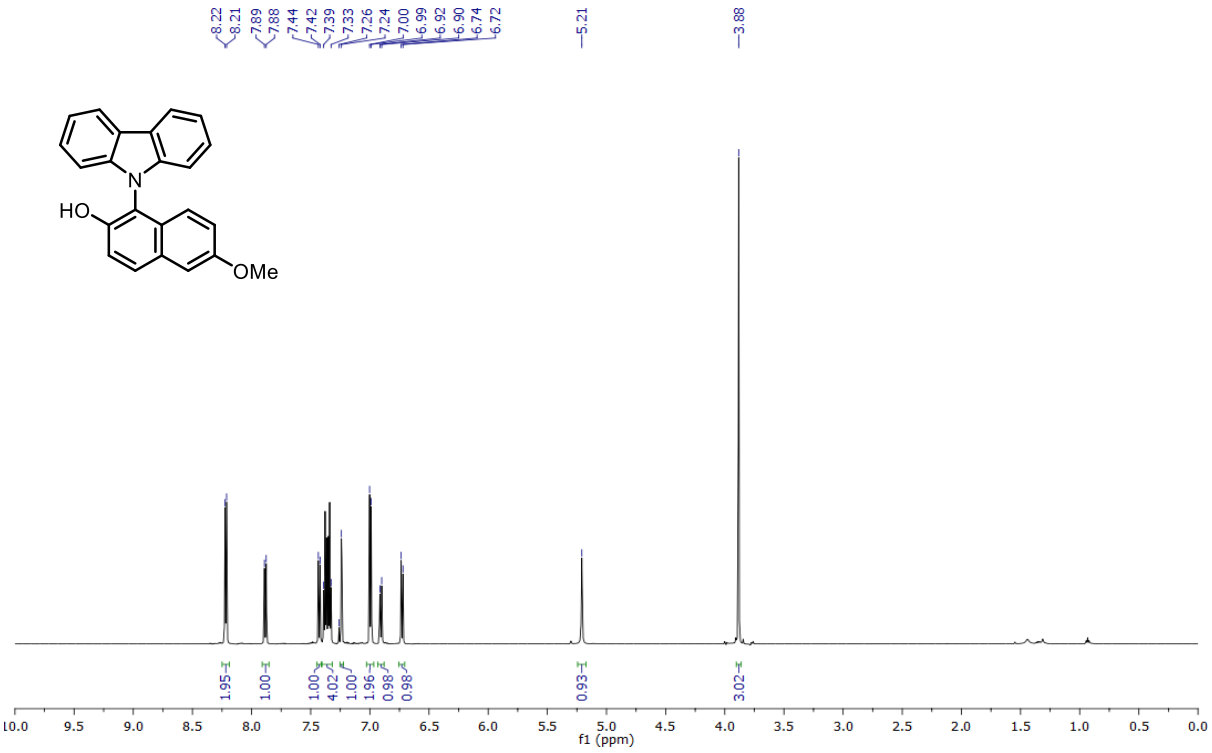


^{13}C NMR (151 MHz, Chloroform-*d*)

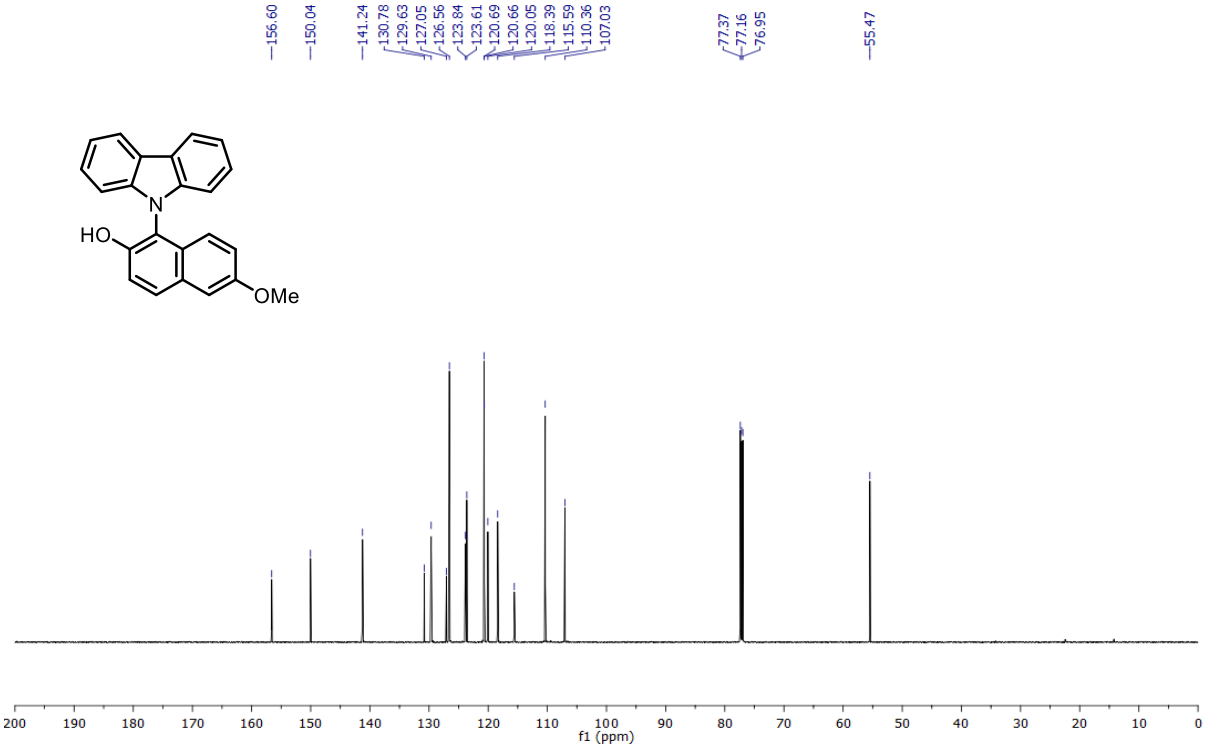


1-(9*H*-Carbazol-9-yl)-6-methoxynaphthalen-2-ol (7p)

^{1}H NMR (600 MHz, Chloroform-*d*)

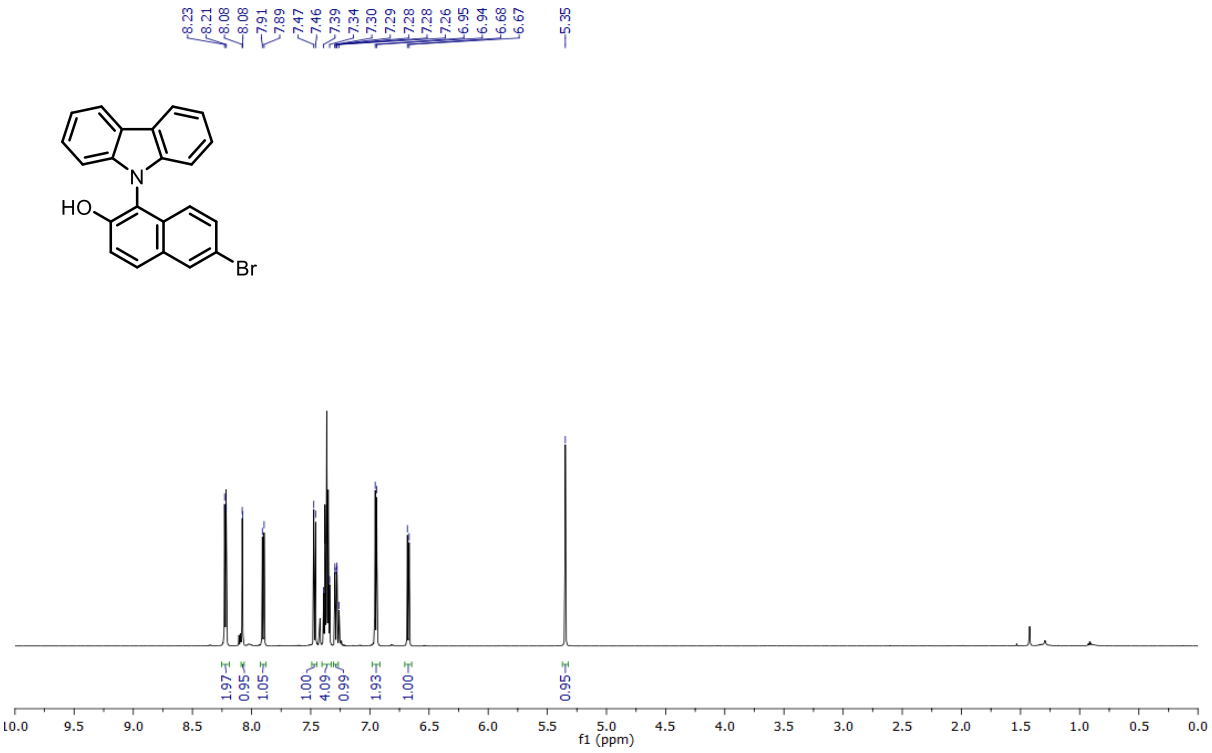


^{13}C NMR (151 MHz, Chloroform-*d*)

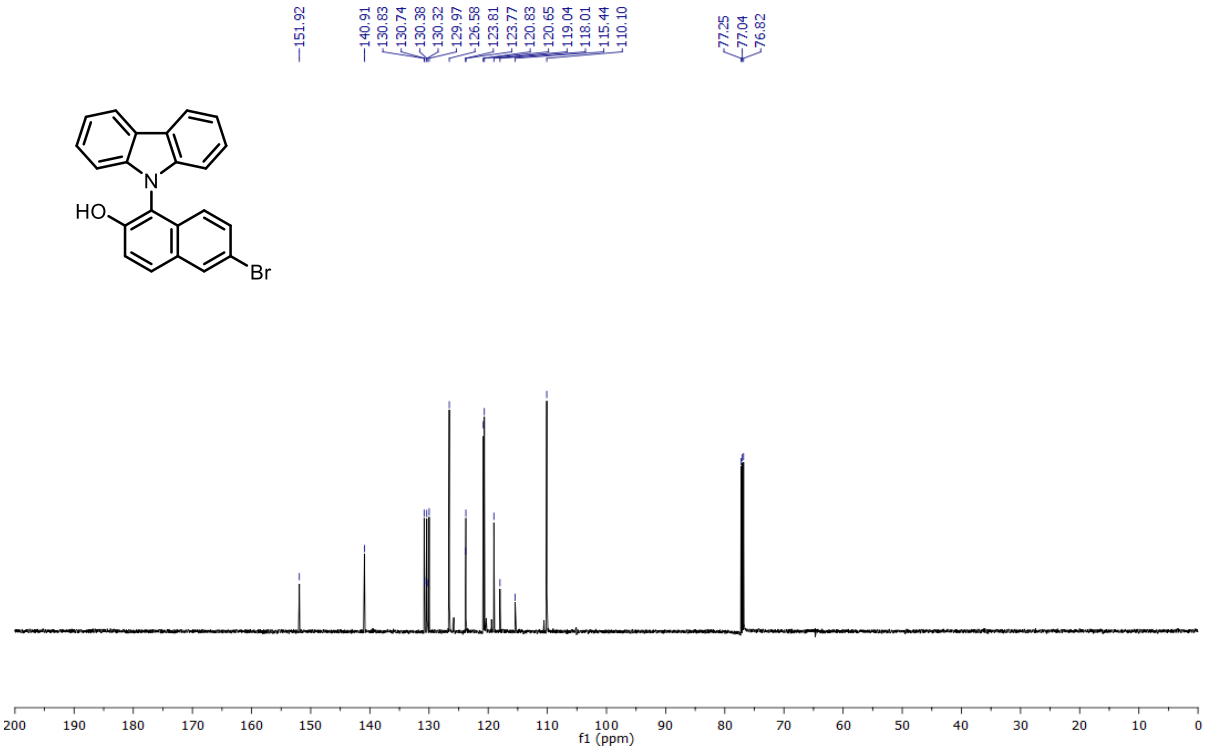


6-Bromo-1-(9*H*-carbazol-9-yl)naphthalen-2-ol (7q)

^{1}H NMR (600 MHz, Chloroform-*d*)

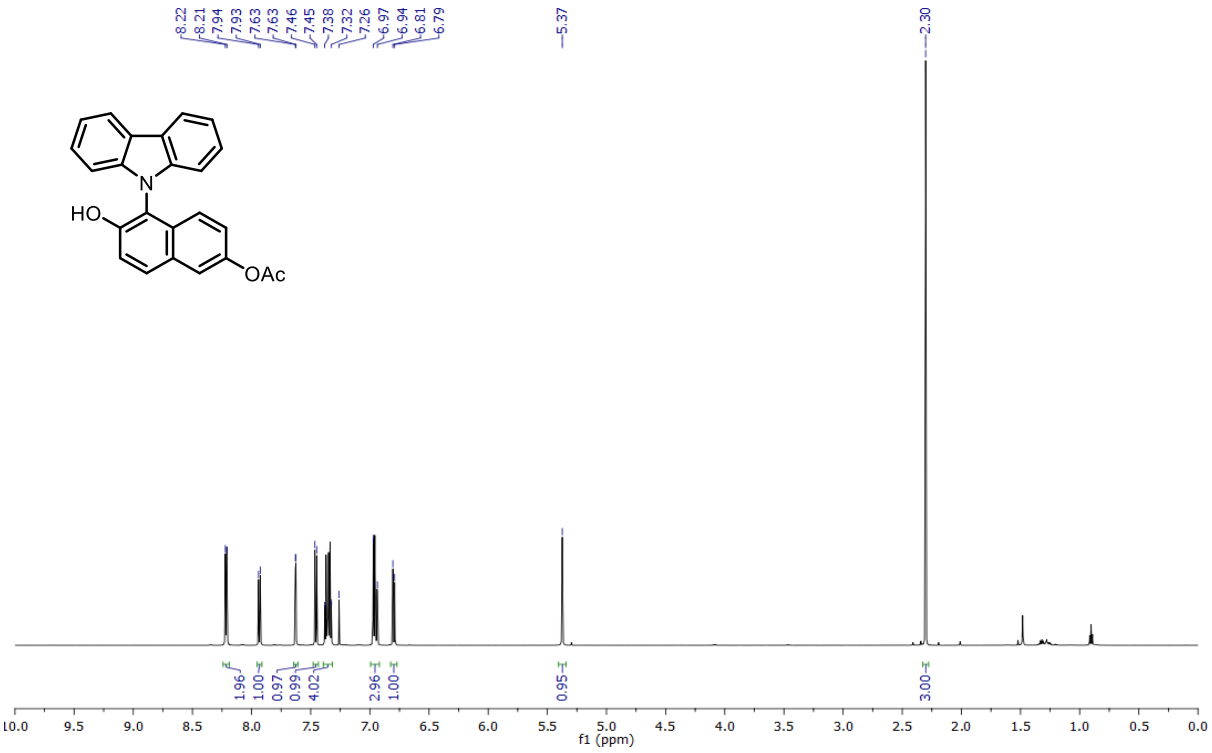


^{13}C NMR (151 MHz, Chloroform-*d*)

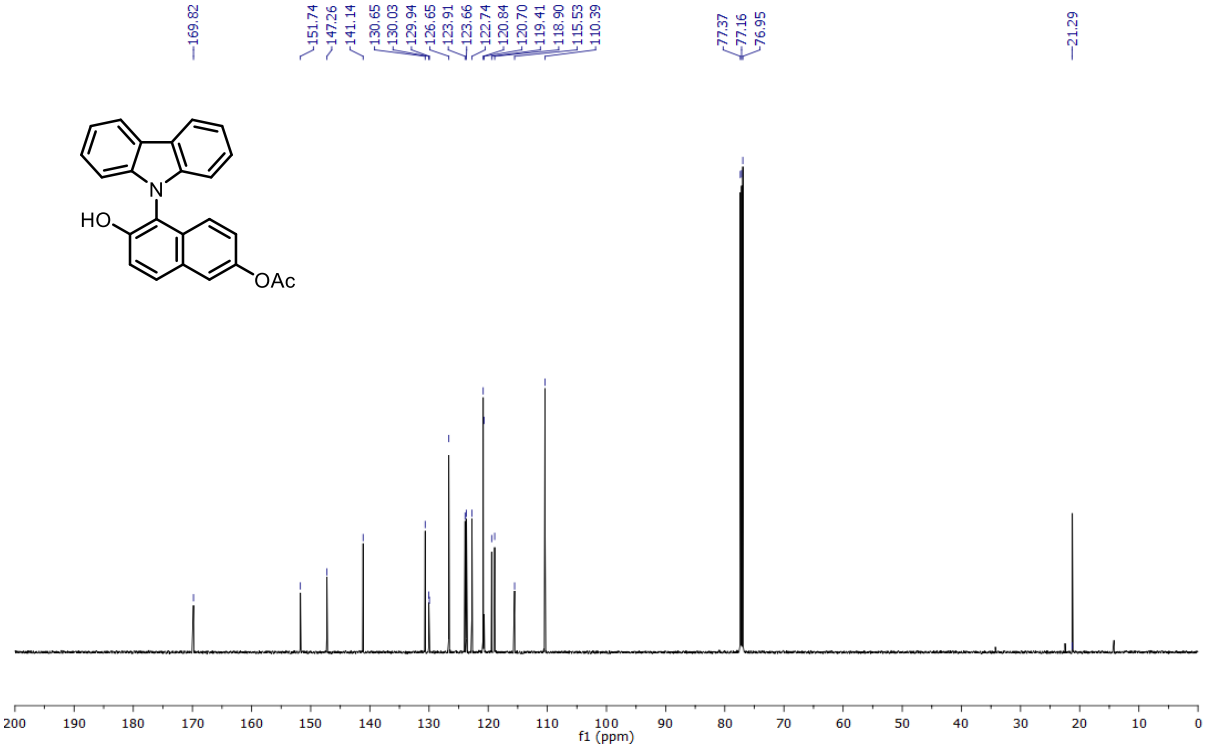


5-(9*H*-Carbazol-9-yl)-6-hydroxynaphthalen-2-yl acetate (7r)

^{1}H NMR (600 MHz, Chloroform-*d*)

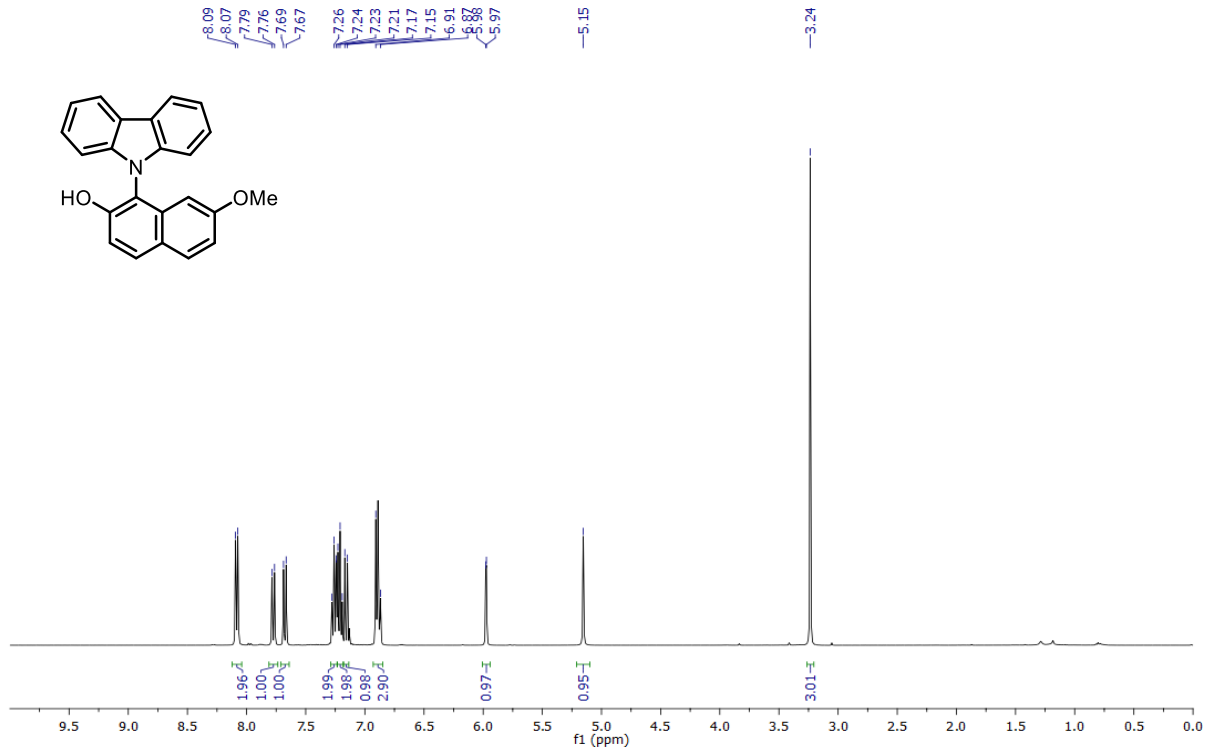


^{13}C NMR (151 MHz, Chloroform-*d*)

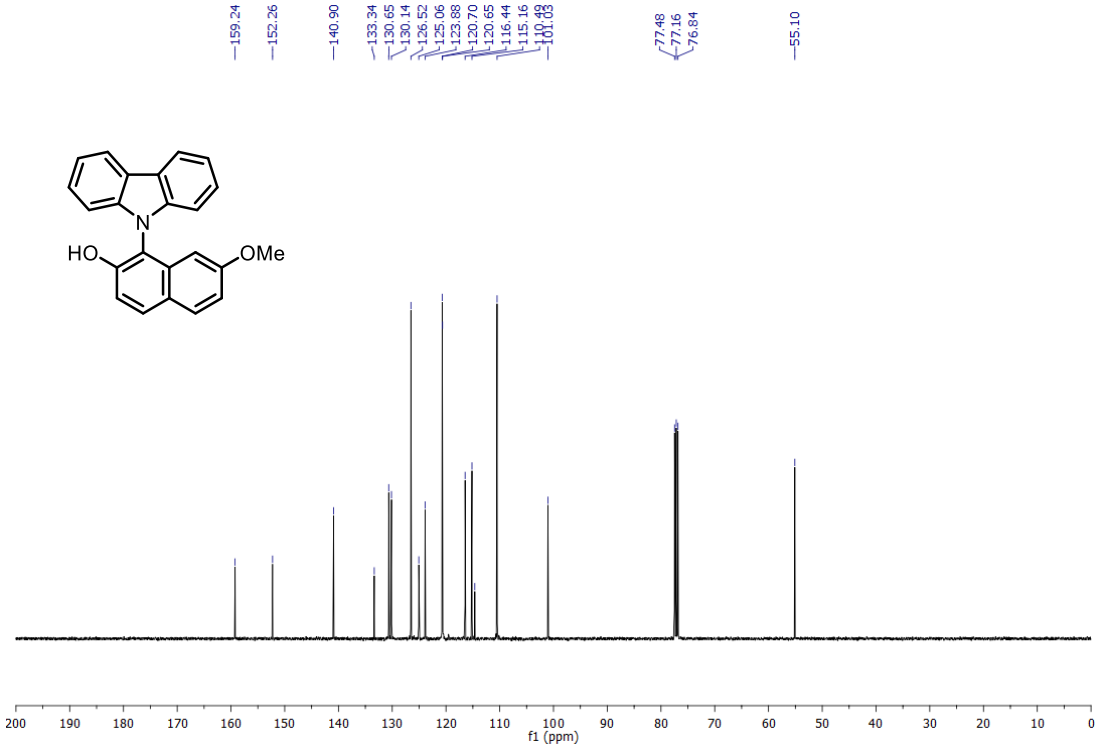


1-(9*H*-Carbazol-9-yl)-7-methoxynaphthalen-2-ol (7s)

^{1}H NMR (400 MHz, Chloroform-*d*)

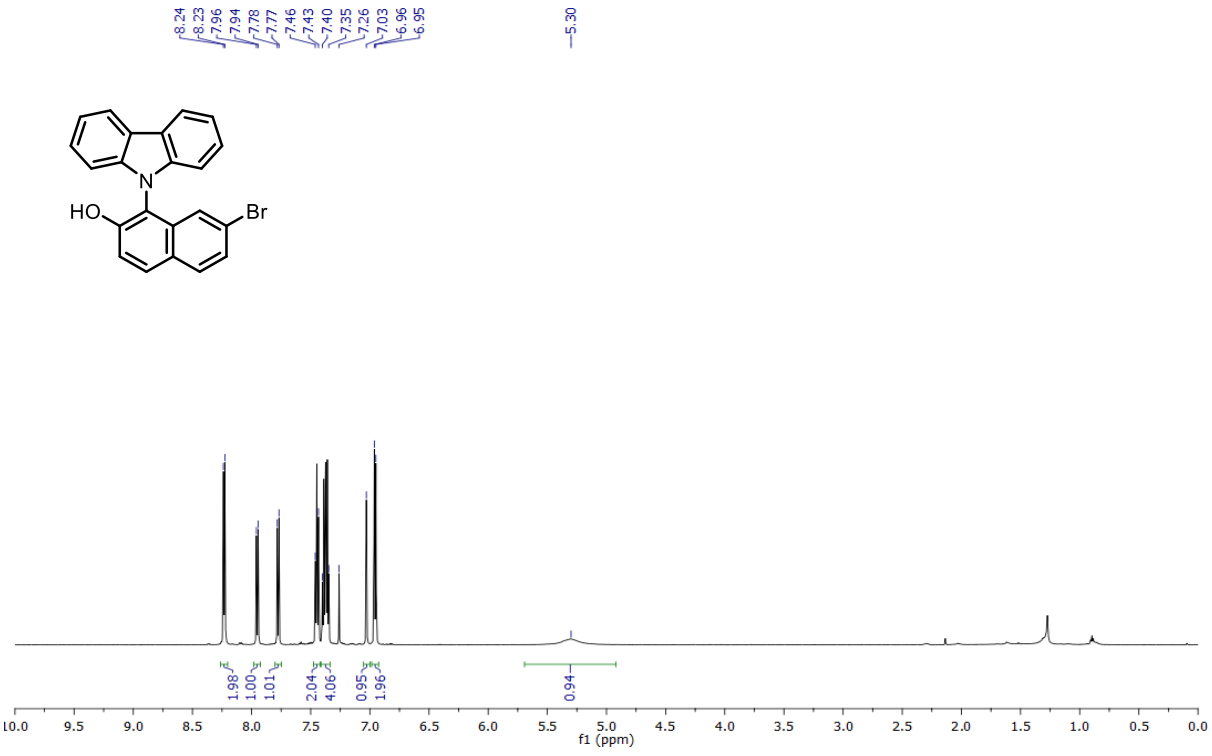


^{13}C NMR (101 MHz, Chloroform-*d*)

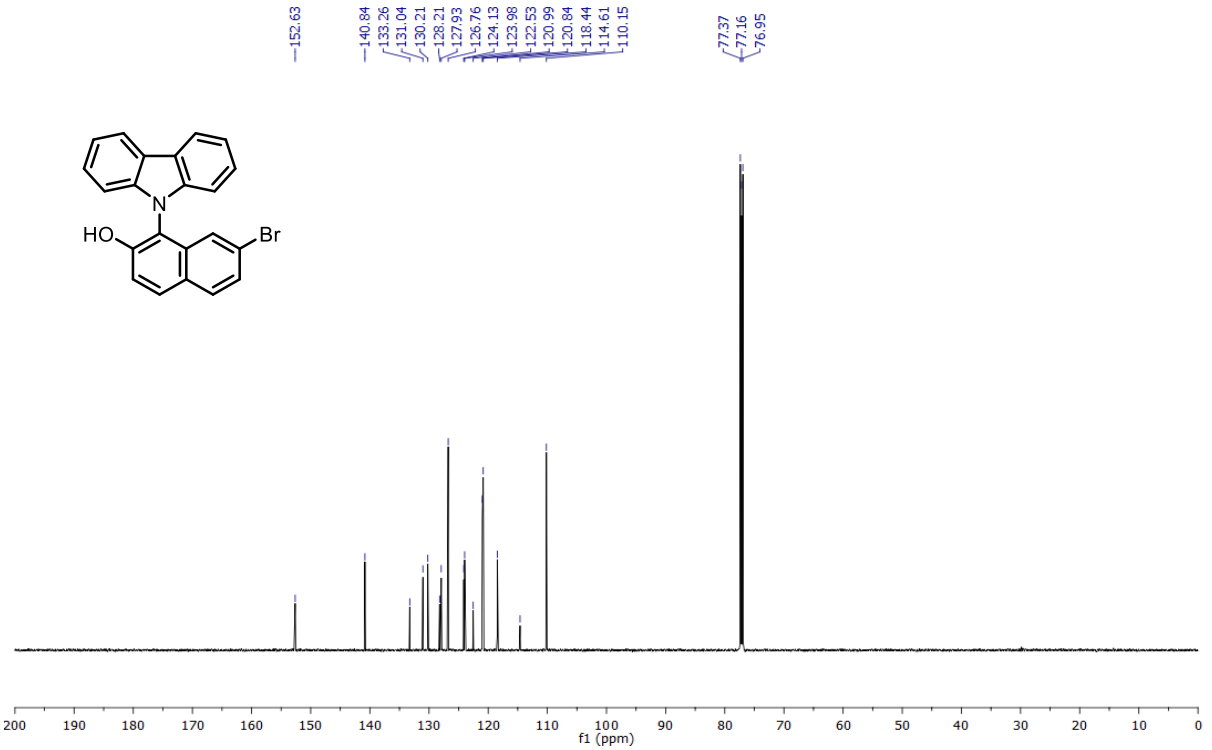


7-Bromo-1-(9*H*-carbazol-9-yl)naphthalen-2-ol (7t)

^{1}H NMR (600 MHz, Chloroform-*d*)

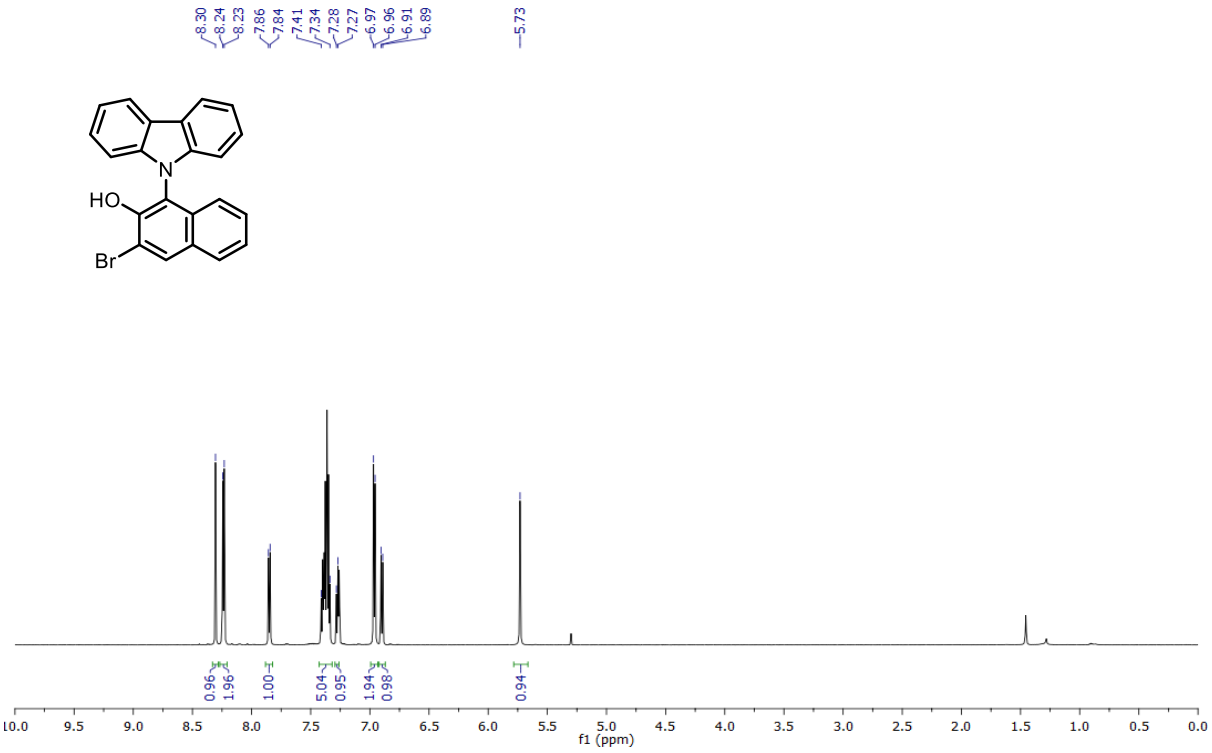


^{13}C NMR (151 MHz, Chloroform-*d*)

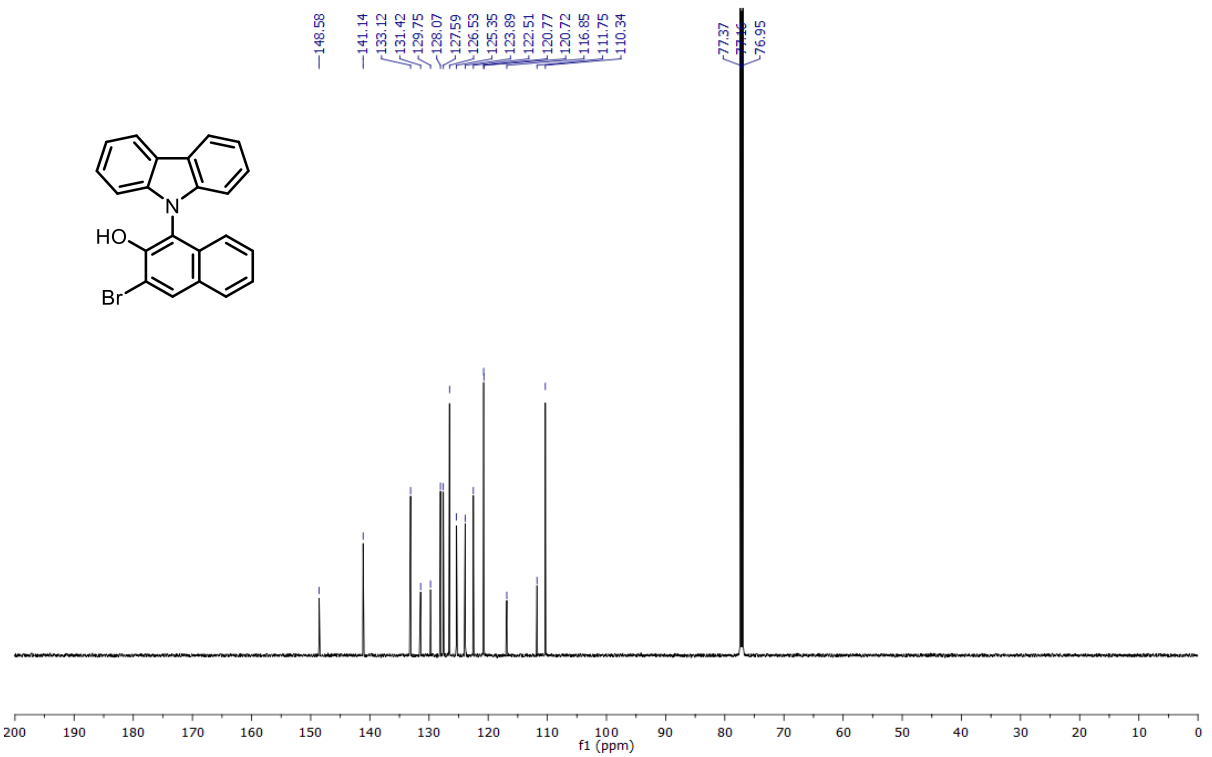


3-Bromo-1-(9*H*-carbazol-9-yl)naphthalen-2-ol (7u)

^{1}H NMR (600 MHz, Chloroform-*d*)

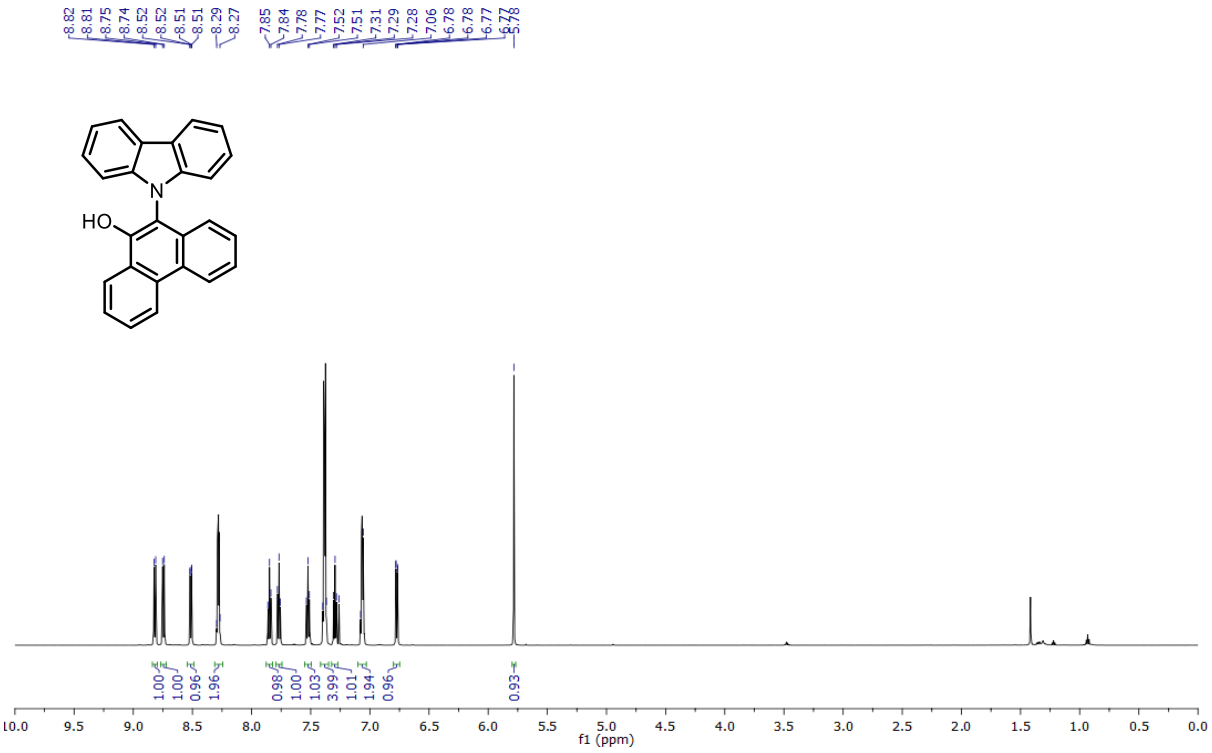


^{13}C NMR (151 MHz, Chloroform-*d*)

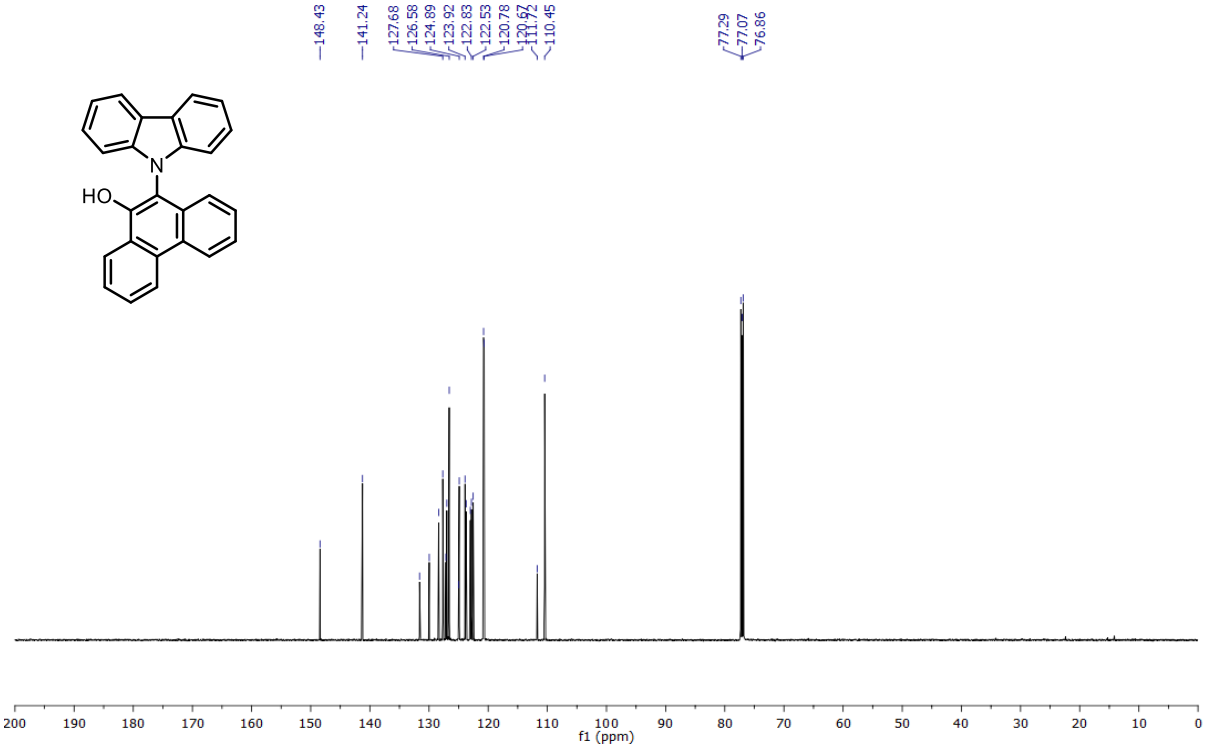


10-(9*H*-Carbazol-9-yl)phenanthren-9-ol (7v)

^{1}H NMR (600 MHz, Chloroform-*d*)

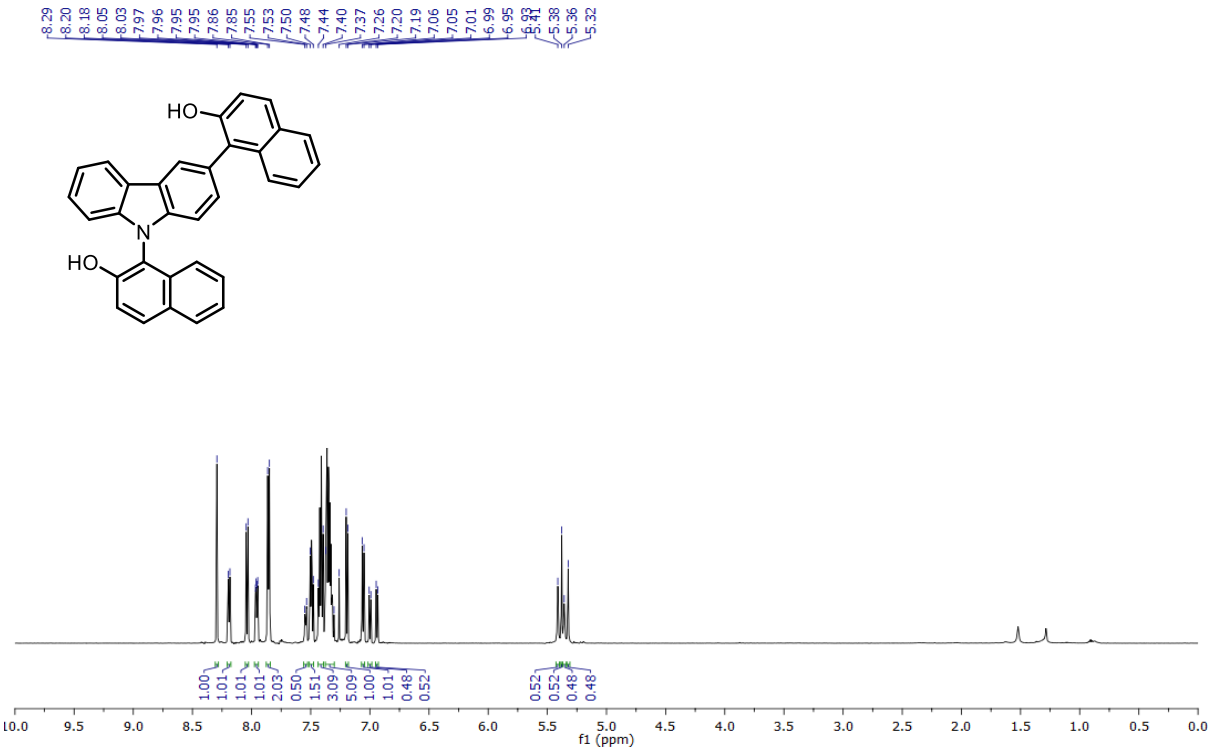


^{13}C NMR (151 MHz, Chloroform-*d*)

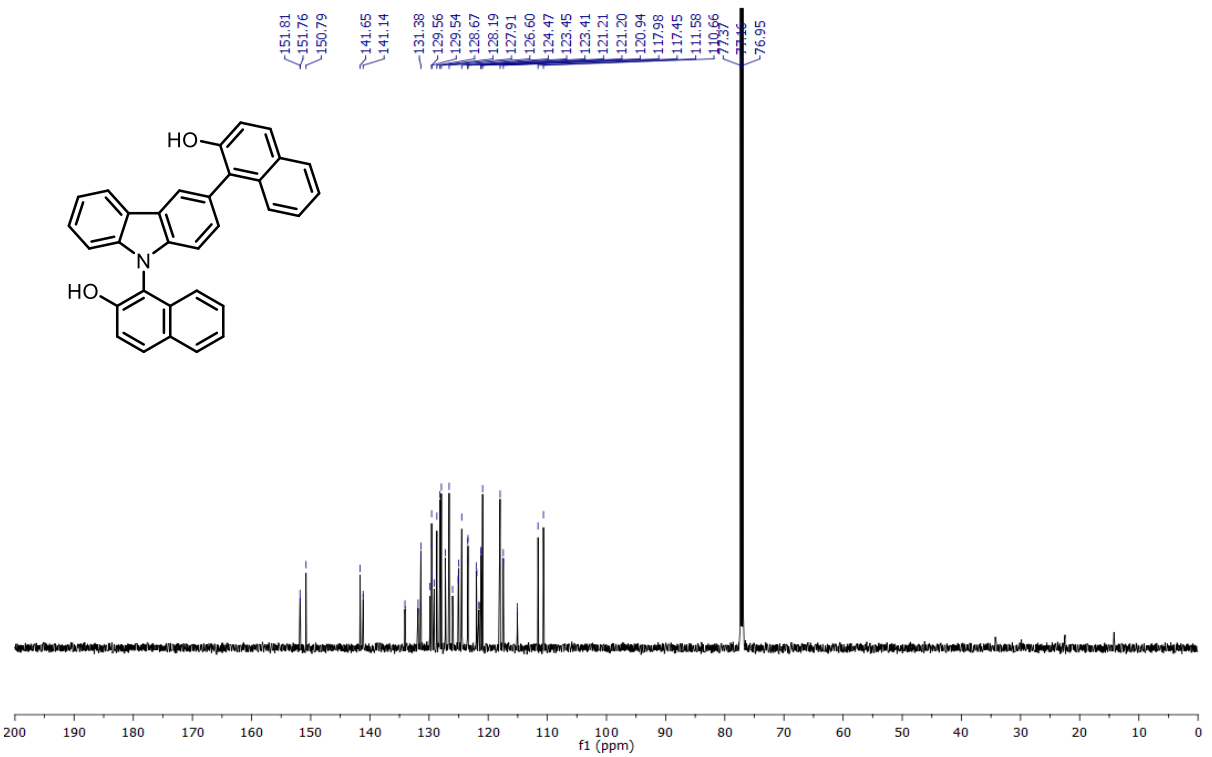


1,1'-(9*H*-Carbazole-3,9-diyl)bis(naphthalen-2-ol) (8)

^{1}H NMR (600 MHz, Chloroform-*d*)

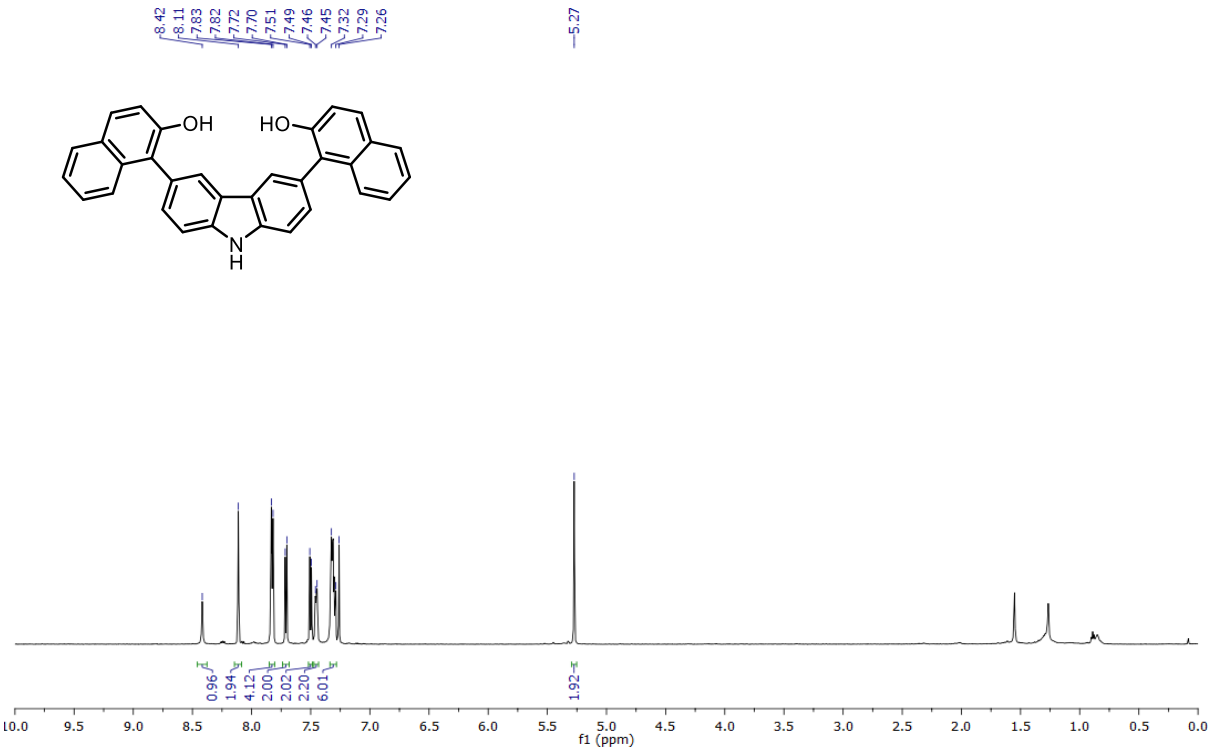


^{13}C NMR (151 MHz, Chloroform-*d*)



1,1'-(9*H*-Carbazole-3,6-diyl)bis(naphthalen-2-ol) (9)

^{1}H NMR (600 MHz, Chloroform-*d*)



^{13}C NMR (151 MHz, Chloroform-*d*)